ORAL CANCER

By

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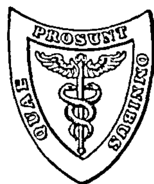
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With the utmost humility this book is dedicated to
THE AMERICAN CANCER SOCIETY
those who have done most toward furthering the
advancement of cancer research
and treatment.

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Preface

An appropriate introduction to the preface of such a book might be stated in the words, "The subject is a very timely one". However, such a statement is not the full truth. Indeed it is known and may be stated without fear of contradiction that "CANCER" is always a timely subject. The fact has been presented to us often and it will be found to appear on several occasions in the following chapters that cancer is second only to heart disease as the killer of man. Then should it not be expected of us, whether we be of the lay or professional, to pursue this monster with all of our armamentarium? We may well understand too that he who fights, fights best when well equipped.

With the foregoing statements shall we say then that the purpose of this volume is to arm and forewarn those who wish to partake of the compilation of its contents.

Repetition of certain statements and quotations from authorities are not herein placed for the purpose of occupying space. Emphasis is intended here, for emphasis is one of the basic principles of teaching the mind to be retentive. Repetition too is made for those who may not have a need for, or an interest in, all phases presented and wish to cover only selected portions.

Let us understand also that this was not prepared with intentions of delving into the depths of the chosen subject Rather it was compiled from the knowledge of numerous authorities and the experiences of the author in order that the average dental and medical practitioner as well as many others connected with the field of the healing arts may be able to advise and direct the afflicted ones as soon as possible in the most accepted manner. We might re-word an old proverb here and say truthfully, "Procrastination is the thief of life", and nowhere does it apply with more force than it does when dealing with cancer, therefore, if those who see the patient first are able to direct him in the most advantageous path, he has a much better chance of survival. Here too another

proverb is recognized for its value, "An ounce of prevention is worth a pound of cure".

My most profound gratitude goes to those who aided in many ways in the preparation of this volume. I would like to thank our present dean at the University of Tennessee College of Dentistry and my professor of pathology while in school, Dr. James T. Ginn, for his contributions, advice and allotment of time for this compilation, Dr. Milton Siskind, assistant professor of oral medicine for his timely suggestions; Dr. Harwell Wilson, chief of staff of the division of surgery at both the University of Tennessee College of Medicine and John Gaston City-County Hospital; Dr. Ralph R. Braund; Dr. Joe M. Chisolm; Dr. David S. Carroll; and Dr. Ralph S. Lloyd.

Memphis, Tennessee J. R. BOURGOYNE

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1

Theories of Cancer Etiology

ONE of the foremost problems today in the mind of Medical Science throughout the world is the question of cancer etiology. The disease which we now term cancer has been known to exist for several thousand years, however, the exact origin of this disease remains as a vague one. Millions of dollars and thousands of scientific minds are now being utilized and placed hard at work in search of any knowledge that will shed some light upon the etiology of cancer, for herein lies the secret of more definite control and eradication of the disease. It is due to the undying effort of these men concerned in this quest that we have arrived at many theories of the etiology of cancer, any one of which might prove to be the solution. Of the many theories, there are several which are most generally agreed upon as being the most logical. Each of these theories will be discussed further, later in the chapter. The etiology of cancer being little understood is made apparent by the fact that few authorities agree on the subject. Theories are still being introduced in great abundance. No disease that has afflicted mankind has received as much attention as cancer in a diligent search to find its nature and cause. The diseases which at one time seemed to threaten the very existence of the race, such as tuberculosis and syphilis, have now sunk into relative insignificance, because medical science has revealed their true nature and conquered most of the causes of their ravages. Because its true origin is yet unknown, cancer is ever increasing in frequency with rapid strides, and now looms as a national scourge. Accepting the fact that the exact etiology of cancer is definitely unknown, an attempt will be made to set forth only the theories now existing on the etiology of cancer.

First, let us define cancer. The word cancer originally referred to the condition of carcinoma but through constant use as such it has come to mean any malignant tumor. According to Behan, "Cancer is a biologic variation in which the cells have acquired a high power of development and multiplication, but have lost the power of contact". Only when a cell growth is definitely cancerous and has gained the distinguishing characteristics from normal

tissue can it be recognized.• The most outstanding distinguishing characteristic of cancerous tissue is its power to invade neighboring normal tissue either as singular cells or en masse. The invasion is by infiltration, with no tendency towards encapsulation. A benign tumor, on the other hand, increases in size, pushes aside the surrounding tissues, but does not invade. The cells of cancer are without useful function, and are destructive to the organism. It is growth and reproduction without control In the development of cancer, fundamental biological principals are violated, for cancer is related to uncontrolled biologic activity. In order to study the cause and effect relationship of cancer, we must consider the changes which so modify physiologic processes that the cell loses its structural entity and becomes cancerous. The three fundamental activities of the normal cell are: (1) growth and development, (2) function of life processes in the cell, and (3) the act of reproduction. Behan states that the first and last of these are more important in the production of carcinomatous tissues than function.

In normal tissue, regulated and coordinated growth, development, and reproduction are the result of controlled cellular activity. In malignant tumors, the cellular growth serves no purpose, is uncontrolled, and is not the result of a biological necessity.

•Throughout the years, attempts at explaining the origin and growth of cancer have advanced numerous strange theories. The ancients knew cancer. It is mentioned in the Papyrus Ebers (1500 B.C.), and in the remnants of the oldest literature of India and Persia. Such ancient scientists as Hippocrates and Celsus attempted to distinguish gross varieties of cancer and to prescribe treatment for these unnatural conditions. Speculation as to the cause of this disease was general and continued for many centuries to be a fascinating subject. Galen (131 to 203 A.D.), was the founder of experimental physiology and pathology, and though he failed to make any advance in the conception of cancer, the humoral doctrine of atra bilis in his writings formed the scripture which dominated medical thought for more than a thousand years. He thought that there were four fluids in the body—blood, mucus, yellow bile, and black bile. An excessive accumulation of black bile was thought to be the cause of cancer. "Open" cancers were cauterized or treated by excision, while vegetable diets were recommended for internal cancers. Walnuts were specifically forbidden in the diet.•

In the seventeenth century, Galen's doctrine was demolished by the discovery of blood circulation by Harvey in 1628. Malpighi used the microscope and found that the black bile was nowhere

to be found, instead, blood and lymph were everywhere. He postulated that lymph coagulated and varied in density, and formed cancer. The period of research that followed was one during which the lymph theory held sway. While English and French students added important contributions to the descriptive history and pathology of tumors, they failed to pass the limits of the prevailing theoretical conceptions of the time.

With the construction of the achromatic microscope in Paris in 1824, a new era in cancer research was opened. Studies of vegetable and animal tissues were made, showing with this instrument that the growth of tissues resulted from the multiplication of cells. Regardless of their careful histological studies of tumor tissue the writers of this period were led to believe in the origin of cancer from a fluid blastema. Cancer was defined as an organized exudate from the blood with over-nutrition and over-growth.

Virchow advanced the first really rational theory of causation. He believed that if irritation of a chronic nature existed for a long time, the irritation produced a granulation tissue which brought about changes in the connective tissue and resulted in a cancerous lesion. He clearly defined cells as always arising from previously existing cells. However, Remak opposed his view that cells could only arise from cells of the same type. His theory was supported by Thiersch. Thiersch also associated cancer with diminished nutrition, function capacity, and mechanical resistance.

Waldeyer, following up Thiersch's work, postulated that all carcinomata were epithelial growths derived from the corresponding epithelium, and that the secondary growths were the offspring of transplanted cells, and not a transformation of the tissue in which they occurred. He also conceived as did Virchow, that repeated irritation was the essential factor.

Cohnheim expressed a viewpoint much like that of Remak. He surmised that cancer arose in persistent embryonic rests, which, because of their displacement from their normal environment, had not been incorporated during the normal development of the organism and had not degenerated Thus cancer was a renewal of embryonic growth. He did not explain, though, why these cells remained dormant for years, nor why only an occasional cell rest developed into cancer. There were many arguments pro and con on Cohnheim's theory. It is now known, however, that tumors and malignant new growths do arise at times from what are the results of anomalies of development, for example, teratoma and mixed tumors.

There was also existent at this time the theory that cancer was caused by an external parasite. It was held that cancer was infectious because it resembles tuberculosis, but this view is based on a false analogy, as has been proven. In tuberculosis the tubercle bacillus is the cause of the disease, while in cancer actual portions of the body grow in places where they should not be, having themselves been transported. One might say that one part of the body has become parasitic upon the other.

In an earnest effort to maintain the supremacy of their science, pathologists of the last century were so busily engaged with the assortment, classification, and digestion of the facts which had been accumulated in relation to structural variations and abnormalities that little real progress was made in clarifying the etiology of malignant tumors.

With the dawning of the twentieth century came the era of experimental cancer research. None of the past theories concerning the essential cause have proved demonstrable, and attention has come to be more or less confined to the determination of predisposing factors so that working out from indirect causes, the direct cause may be found

Endless experimental work is now being done in research laboratories throughout the world, with reference to the influence of heredity, irritation, environment, diet, etc., upon the cause of this disease. Experiments are being made upon animals, and even in some cases upon human subjects. The theories concerning the origin of tumors are more numerous than the varieties of tumors themselves. The best-known theories of the time are. (1) heredity, (2) embryonal theory (Cohnheim), (3) irritation theory (Virchow), and (4) parasitic theory.

To the above group of theories, one might add several others, though some of which are held in ill repute by man, seem logical to others. Some of these are: (1) the endocrine theory, (2) the chemical theory, (3) the bacterial theory, and (4) avitaminosis

It is being accepted by an increasingly greater number of scientists that the most fundamental of the systemic causes of cancer is a modified hereditary influence or tendency It has been concluded from the study of cancer in lower animals that there is a hereditary tendency in certain animals, but as yet this theory has not been extended to apply to human beings The most enlightening knowledge has been given this subject by Maude Slye, who did much to convince the medical profession of the existence of an inherited predisposition to cancer. She carried out her work at the University of Chicago in the Cancer Laboratory, using mice as

the experimental animal. She took the utmost care to rule out errors that might complicate the experiment. Her work was so thorough that the student of cancer is almost bound to coincide with many of her viewpoints. According to her research, selective breeding may ultimately produce strains of animals in which different organs will acquire a definite predisposition to certain cancer types. From her work a theory of cancer inheritance was developed which states that: Malignancy is transmitted as a localized recessive character which is capable of suppression by a dominant unit. The localization of a malignancy is determined by localization factors that provide the occasion for malignancy in tissues that are capable of malignancy, if there exists an external causative factor in the correct interrelationships. Her theory states that cancer is hereditary, with one recessive character for carcinoma, one for sarcoma, and one for leukemia, also the location of the cancer is determined by these recessive characters, with a different recessive character for each of the different locations that cancer may be discovered.

The viewpoint of Maude Slye accords with that of Leo Loeb, who believes that in mice there is not only an inherited predisposition to cancer of a certain type, but also that there is present a predisposing factor which determines whether the transformation of the normal into cancerous tissue will be accomplished within a certain age period. He also says that the inheritance of a cancer predisposition is restricted to a certain type and to a particular organ. He believes that the cancer predisposition inheritance is analogous both in men and in animals.

These experiments, carried out on mice and from which the above mentioned gained their theories, do not necessarily hold true for human beings. However, it is a known fact that there is more of a tendency for the children of families who have a high rate of cancer to develop cancer than there is when there is no cancer in the family. The question of inherited susceptibility in the origin of human cancer is still not definitely answered

The evidence favoring the doctrine of hereditary disposition to cancer consists mainly in records of "cancer families" and in statistical studies of the incidence of the disease in the relatives of numerous cancer patients.

In 1837, Warren reported a family history in which the grandfather had cancer of the lip, while the son, his daughter, two sisters, and one of their daughters died of the same disease. The most noted cancer family was that reported by Broca, 1866, of Madame Z, the details of which were furnished by a member of

the family who was of the medical profession. Of 26 members, mother, children, and grandchildren, reaching the age of thirty, 16 died of cancer of the breast, liver, or uterus. Napoleon I, his father, also one brother, and two sisters, are said to have died of cancer of the stomach.

Through her elaborate experimental studies, Maude Slye has derived the following seven conclusions which she prefers to apply to tumors which may be said to be inherited:

(1) The inheritance behavior of neoplasms is that of a Mendelian recessive.
(2) Double cancerous parentage yields 100 per cent tumor strains except where some individuals die of infections before they reach the cancer stage.
(3) Single cancerous parentage yields heterozygotes (transmitting but not themselves developing cancer) in the first generation.
(4) The mating of a cancerous with a heterozygous individual gives approximately 50 per cent cancerous and 50 per cent heterozygous offspring.
(5) Double non-cancerous parentage yields 100 per cent non-cancerous strains.
(6) The tendency to cancer, therefore, is inheritable, as no character except one which is hereditary can behave in this manner.
(7) The tendency to tumors of specific organs and of specific types is also inheritable.

Other geneticists, however, do not accept all of Slye's theories from her data. They are inclined to believe that there is, no doubt, a susceptibility to cancer in various families and strains of animals. Clinical studies indicate that there is among humans a general susceptibility to tumors, which in rare instances become pronounced and effective, but that, as a rule, this susceptibility is negligible and the disease does not develop until other exciting factors, which are the real effective causes of the disease, are brought into play. The predisposition may be congenital without being hereditary.

Ayre and Ayre have proposed one of the accepted theories of today, by combining the old irritation theory and more recent studies. Their theory is one of "cell reversion". This theory may also be linked with that of Cohnheim, or the embryonal theory. They make the statement, "It is proposed that cancer is essentially a reversion in cell evolution resulting from an abortive attempt of the regenerating cell to adapt itself to an environment that is deficient in one or more of the elements essential for the formation

of the enzyme pattern it requires to become a fully differentiated specialized cell".

They have shown a likeness in cellular enzyme patterns of cells of malignant and embryonic tissue, and that certain chronic low grade tissue vitamin deficiencies resulting in impaired metabolism of the adult cell are of sufficient intensity to cause a reversion of the cell enzyme metabolism to one comparable to embryonic growth and development. When a change of cellular metabolism exists, there exists a relatively low concentration of one or more of these elements which is insufficient to permit the manufacture of the necessary adult enzyme system, but is sufficient for the production of an embryonic enzyme system. If these conditions persist, chronic marginal deficiency and continuously forced local tissue growth, and a change in the tissue will be caused and eventually these tissue cells assume the behavior patterns of the primitive embryonic cell.

There is no definite evidence to show that the malignant cells have the same concentrations of certain vitamins in their enzymes as found in the primitive cells; there has been shown a definite similarity in deviation from the adult normal.

The comparison may be made in cellular reversion and the theory of embryonic rests. One might ask whether the cells that are supposedly reverting to an embryonic state are really regressing or whether they are "embryonic rests", or displaced embryonic cells which do not proliferate until there is some sort of irritation that causes them to develop into a cancerous lesion. Here again, we see the overlapping of the theories concerning the possible etiology of cancer.

Perhaps the most widely accepted of all theories on the etiology of cancer is the concept of chronic irritation. The irritation theory was first brought into being by Virchow as we have mentioned earlier. He based his viewpoint on the fact that he frequently noticed tumors where there was a continued chronic irritation by which cells are formed in excess and normal recession does not occur, as at the site of a chronic inflammation. Such reactions cause disturbances which produce abnormal modifications in tissue equilibrium and lead to hyperplasia and in some cases cancer.

The concept of cancers resulting from chronic irritation is evidently based on the frequent coexistence of chronic inflammatory processes with precancerous and cancerous manifestations. Chronic cervicitis, chronic mastitis, chronic dermatitis following exposure to tar or roentgen rays and cirrhosis of the liver are considered conditions leading to cancer, and this supports the concept of carcino-

genesis by nonspecific chronic irritation. However, there are experimental observations and much clinical evidence to show that chronic irritation is noncarcinogenic. Wherever cancerous processes are observed in chronically inflamed tissues a specific carcinogenic factor should be sought. Cancers of the nasal sinuses are relatively rare though chronic sinusitis is one of the most common diseases. Chronic urethritis and chronic salpingitis also are rather frequently occurring diseases, while cancer of the male or female urethra show a conspicuously low rate of incidence. Recent studies by Carstam have confirmed that hemorrhoids are not more frequent in cases with low cancer than in cases with tumors situated further up in the colon and are found with about equal frequency in patients with rectal or colonic cancers and in patients without intestinal cancer. Ashton noted that cancer of the cervix is rarely seen in the completely prolapsed uterus, although the cervix is subjected under such conditions to continuous physical and chemical irritation. He also called our attention to the fact that the development of cancer of the lung is seen with the inhalation of certain types of dust, fumes, vapors, or gasses (chromate, nickel carbonyl, tar, arsenic, radio-active agents), but is not associated with the inhalation of others (silica, coal, and cement). These observations suggest that greater efforts should be made in ascertaining specific causes of cancer which may be hidden behind common chronic irritative processes. These observations again demonstrate the flexibility and argumentation about the etiology of cancer according to the irritation theory. Preventive control depends on the existence of demonstrations of specific causes.

Most dentists believe that cancer of the oral cavity is closely allied with bad teeth, the irritation of continual use of tobacco, and syphilis. It may be true, too, that congenital disturbances in the structure of the oral cavity play a minor part in the role of the etiology of cancer. It has been shown that cancer of the oral cavity is very prevalent among the natives of Ceylon who chew an excessive amount of betel-nut, thus producing an almost constant irritation Statistics show that in the oral cavity, 30 per cent of the lesions of leukoplakia will change into the prickled cell or squamous cell carcinoma.

The pathologist knows that certain forms of chronic irritation lesions called precancerous conditions will develop into cancer, yet he is unable to distinguish between those lesions that will and those that will not develop into cancer.

Ewing has listed several factors that have been observed in the relation of trauma to tumors. He notes that in the course of cancer

that results from trauma, there is often a predisposing cause present before the chronic irritation occurs, that might present a precancerous condition when coupled with constant irritation. These predisposing factors as he lists them are as follows:*

(1) "There may be a benign or a minute malignant tumor in the tissue before the occurrence of an injury that causes an irritation. Many patients with cancer of the breast attribute their disease to some form of injury. Probably very few of these tumors are the direct result of the trauma, but a slowly growing cancerous nodule in chronic mastitis may be accelerated by a blow where the injury alone seems to be the immediate cause of the cancer. In any organ a preexisting lesion renders the effects of ordinary injury more severe and more noticeable.

(2) "The precancerous condition may be precipitated into a malignant process by injury. Examples are wounds of a psoriatic tongue by the teeth, injuries of the breast altered by chronic mastitis, and the incomplete surgical removal of indolent ulcers, mucous polyps, fistulous tracts, and benign tumors. Leukoplakia of the tongue is said never to develop cancer until it becomes complicated by cracks and fissures.

(3) "Misplaced and undeveloped organs are predisposed not only to tumor growth but also to trauma. The results of this unusual combination are seen in cancers of undescended testes and supernumerary breasts.

(4) Aberrant quiescent cell groups may be included in the damaged tissue. The best known example is the malignant melanoma arising from an injured mole. Definite injury frequently precedes the appearance of the various forms of teratoma testis, and since trauma is an effective method of producing artificial parthogenesis, there is good reason to believe that the relation of the injury to the tumor in this case is direct, for these tumors develop from immature aberrant sex cells. Throughout the entire series of embryonal tumors there is a sound basis for ascribing more than ordinary significance to a history of a severe or mild and repeated injury. Some think that many adrenal rests are incited to growth by trauma.

(5) "Normal cells under the conditions established by trauma develop benign or malignant tumors. There seems to be no sufficient reason for denying the fact of the relation between trauma and many chondromas, osteomas, lipomas, fibromas, and fibromyxomas, with which the history of a blow is rather common, and

*Ewing, James: *Neoplastic Diseases*, W. B. Saunders Co., 1922.

there is little ground for assuming the trauma acts on any but normal cells. Also with the two most striking forms of traumatic tumors, gliosarcoma and osteosarcoma, where a definite history of injury is frequent, there is no evidence that any but normal cells are involved."

Irritants that are thought to produce a cancerous condition are not only irritants of the mechanical nature, but also those of a chemical nature. According to definition, an irritant is an agent which produces inflammation. By this definition, many of the chemical substances which are said to produce cancer may, on the other hand, never produce cancer. Again we see the ambiguousness and mystery still enclosing the irritational theory. Nevertheless, several chemical irritations that are thought to produce cancer under certain conditions will be enumerated.

Cancers have frequently followed chronic diseases of the skin, frequent application to the skin of tar, anilines, soot, paraffin, and mineral oil. Cancer of the stomach seems to occur more frequently in those persons who consume considerable amounts of whiskey. Some also believe that cancer may also follow chronic ulcer of the stomach. Applications of tar to mice has produced malignant growths, but even though tar is considered an irritant, there are some of the constituents of the tar that are thought to be the actual carcinogenic agents. These agents are: dibenzanthracene, methylcholanthrene, and benzopyrene. Tar not only produces cancer of the skin, but also in the stomach, urinary bladder, and uterus of rats, and the gall bladder of guinea pigs. In regard to tar cancer one authority mentions that the etiological agent to be effective, must be adapted to the tissue and that certain irritants may be nonspecific or specific for one kind of cancer growth. He also states that age is an important factor in the formation of malignant growths, and that tar is effective in both men and mice, hence the importance of the experimental work with tar. Kennaway of England noted that persons who worked in contact with tar, mineral oil and aromatic amines had an increased susceptibility to cancer of the skin and cancer of the bladder.

It is thought that all irritants of the chemical nature are not external. Some may be produced within the body. Such is the case of sulfydryl compounds which are released from the tissues due to injury or disease. They are believed to be powerful exciting agents toward formation of malignant growths.

Dibenzanthracene, benzopyrene, and methylcholanthrene have been injected into animals with resultant malignant growths Sarcomas resulted from subcutaneous injections whereas carcinomas

developed when the above agents were applied to an epithelial surface. Intracerebral implants of methylcholanthrene have produced glioma. With the use of methylcholanthrene, skin cancer has been produced with single applications, thus disproving the theory that it took a prolonged time for a carcinogenic agent to produce cancer.

Other carcinogenic agents producing cancer have been experimented with. Arsenic, taken over a period of time, produces malignant growth. Zinc chloride when injected can produce teratomas. Other factors that are believed to produce cancer as chronic irritants are long period of exposure to the sun, inclement weather, x-ray, and radium. Yet x-ray and radium are both now used in the treatment of cancer.

Boyd believes that the carcinogenic agents simply produce a cancerous state rather than actually producing cancer. Edwin Davis notes that carcinogenic agents are very numerous, vary greatly in their chemical structure, may be of an organic or inorganic nature, occur natural or synthetic, and may be either endogenous or exogenous. Some authorities believe that certain roots have artificial components that are potentially carcinogenic. These ingredients are many and some are glucose, sesame oil, lard, olive oil, wheat germ oil, excessive vitamin intake, overcooked meats and others.

The parasitic theory is perhaps one of the oldest theories of the origin of cancer. This theory reached its height of popularity about 1895, but during the last few years it has rapidly lost its place, and today few competent observers consider it as a possible explanation of the etiology of cancer. Much experimentation has been done with injection of microorganisms into animals to prove the parasitic theory, but this is still not so widely accepted.

Some authorities connect the parasitic theory of the etiology of cancer with the virus theory, saying that the tumors caused by parasites' origin are most probably a virus which is harbored by the parasite and which acts as an inoculum, making the host susceptible to the virus. Oberling states that tumors which are attributed to chemical agents may be of a virus origin. He proves this by a count of rabbit experiments in which tar was placed on rabbits' ears until tumors developed. If virus were added to these tumors they became malignant, otherwise they regressed. He also added that so-called hereditary cancer is not the true case, for the virus of cancer is transmitted to the child by contacts with the parent.

In connection with the virus theory, Glover has shown that cancer could be produced in guinea pigs by inoculating them with a suspension of microorganisms taken from human cancer. He also explained that patients having inoperative cancer who were injected with a serum from horses immunized against a few strains of virus improved, and in some cases, there was a regression of the disease and complete cure.

Estrogenic substances are considered by some to be etiological agents in cancer formation, but they are thought to be specific in their action for there is some evidence that they are agents in producing cancer of the breast and the uterus. Through experimentation, the injection of estrogens into male mice has resulted in mammary cancer and the removal of the ovaries in female mice has resulted in reduction of mammary cancer to almost nothing. The female mice that were used were from strains with a high history for cancer. Cancer of the breast has been noted in women giving a history of late menopause and persistent endometrial hyperplasia. Late menopause gives rise to persistent estrogenic activity which in turn results in recurrent and prolonged stimulation of the endometrium. This is thought to be predisposing to cancer Large doses of estrogenic substances may be harmful and may even result in cancer of the breast or the uterus when taken during menopause.

Now still another etiological factor in the formation of cancer is that of nutrition, though this has never been proven definitely. It is believed that a deficiency of Vitamin B complex is a predisposing factor of oral cancer. Koop and Martin carried on experiments to show the connection between intraoral cancer and avitaminosis B. They claim that such a deficiency could serve as a chronic irritant as do tooth projections, smoking, syphilitic lesions, and alcohol. Yet their research fails to be convincing as a primary factor in the etiology of cancer but more as a contributing factor.

CONCLUSION

✓ Having reviewed each of the currently existing theories of the etiology of cancer, it becomes evident that the true origin of cancer as yet remains unknown. Though the many theories have been proven in some instances, they do not apply in all cases. At the present time, endless research and clinical study is being carried on in quest of this knowledge. Sufficient clinical evidence must be produced before a definite causative factor is established. Not only must this be the responsibility of scientists, but it must also be the duty of the general public to be educated to consent to early

examination to assure earlier and more effective treatment, to allow more clinical research on the course of the disease, and to be cooperative in all ways with those who seek to find the answer to so vital a problem – one that is vital to all humanity. Within the secret of the true origin of the disease lies the passport to control, cure, and prevention of the disease in the future. ✓

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2

Progress in Research on Cancer

CANCER is one of the most serious medical problems with which we are faced today. The latest returns from various countries indicate that cancer is in second place in the list of fatal disease. In civilized lands at least eleven out of every one hundred persons living are destined to die of cancer. In 1946 there were approximately 186,000 deaths from cancer in the United States and it has been estimated that there are over 600,000 cancer patients in this country at the present time. What is to be done about this menace? The natural reaction of man when confronted with danger is to fight, and against cancer a vigorous fight has been going on for many years. This fight has not been without some success.

Abundant historical references lead to the belief that cancer was known to the ancients at least two thousand years ago They worked without lens or microscope and therefore knew nothing about the minute structures of tumors and the various tissue manifestations with which they confused cancer. Imagination was given full play in the evolution of elaborate theories of etiology of cancer. The causative factors involved range from the three "humors" of Hippocrates, Celsus, and Galen, through nearly all the individual tissues of the body, and to a bewildering number and variety of extraneous agencies

Since the beginning of recorded history, the sufferer of cancer has been subjected to every conceivable form of experimentation The fields and forests, the apothecary shop, and the temple have been ransacked for some successful relief from cancer Hardly any animal has escaped making its contribution, in hair or hide, tooth or toenail, thymus or thyroid, liver or spleen, in the vain search by man for a means of relief from this disease.

The history of surgical treatment of cancer assumed rational proportions at a much earlier date than did the non-surgical. As far back as 200 B.C, in the writings of ancient India, are found directions for the removal of cancerous growths Radical excision has been advocated for centuries, but it is only within the last few years that surgical technic has developed to such a degree as

to enable one to say with assurance that it is possible to effect a cure by means of surgical intervention.

Experimental cancer research is little more than fifty years old. A few of the pioneers in cancer research are still active today. Some of the discoveries which greatly aided this research are: the discovery of the microscope by Leeuwenhoek (1632-1723), the isolation of radium by Pierre and Marie Curie in 1889, and the discovery of the x-ray by Roentgen in 1895.

In America the inception of the cancer movement was largely due to Professor Roswell Park. In 1898 the legislature of New York state appropriated a small sum of money for the purpose of equipping and maintaining a laboratory for research on cancer. The money was placed at the disposal of the medical department of the University of Buffalo with Professor Park as director. This laboratory was the first to be devoted exclusively to the investigation of cancer.

In watching the development of cancers that were easily accessible to examination, physicians noticed that they rarely appeared in healthy areas but were nearly always preceded by chronic inflammatory changes. This caused the impression that chronic inflammation and cancer were in some manner related, and when postmortem observation showed that what was true for the skin was equally applicable to many of the internal organs, the suspicion became so strong that by the second half of the nineteenth century clinicians like Broussais and Billroth were denouncing chronic inflammation as the cause of cancer.

Virchow, who is known as the father of the irritation hypothesis, pointed out that every injury to the tissues is followed by a state of irritation, in which the cells at the site are stimulated to multiply in order that the damage may be repaired. If for some reason or another the noxious influence should persist the irritation persists with it, and the proliferation grows more and more excessive and more and more irregular. So Virchow reasoned that if such a condition were to last year in and year out it must necessarily end in cancer.

This doctrine held sway, and for fifty years irritation was discussed from every standpoint but actual knowledge as to the cause of cancer advanced little.

The first experimental investigation of the cancer problem was described in 1775, when the Academie of Sciences and Belles-Lettres of Lyon offered a prize for the best essay on the causes, nature, and prevention of cancer. The winner was Bernard Peyrilhe who reported the transfer of cancer from a human patient to a dog.

This was an error, of course. What had been transferred was not cancer but suppurative microorganisms which had caused inflammatory lesions that were mistaken for malignant tumors.

Other men tried to transfer cancer from man to lower animals without success. Some tried to transfer cancer from one human being to another. In 1808 Fayet, Durand, La Noble, and Biette all inoculated themselves but to no effect.

All the early work was futile. It was carried out under defective conditions and provided no foothold for advance. It was not until near the end of the nineteenth century that a reliable foundation was laid in Germany by Hanau (1889) and almost simultaneously by Moreau in France.

Hanau inoculated metastases from a carcinoma of the skin of a rat into the covering of the testis in two other animals of the same species. Several weeks later he found tumors scattered throughout the peritoneal cavities of both, similar in microscopic appearance to the original growth.

Moreau transplanted a mammary carcinoma of the mouse to other mice, proving his success by microscopic examination. He carried his tumor through several generations and approached the question of immunity.

The work of Hanau and Moreau was shamefully neglected for more than a decade. Then Loeb and Jensen confirmed it and a fury of research set in on all sides. Work went on feverishly until, within a few years, cancer had become one of the diseases most thoroughly subjected to experimental research. Laboratories were organized in almost every country. Rat and mouse tumors laboriously transplanted generation after generation soon came to resemble the strains of microorganisms established and continued by bacteriologists.

Greene was able to transplant uterine and mammary cancers of the rabbit to guinea pigs and other animals by inoculation into the anterior chamber of the eye or into other sites where protective reactions are less vigorous. He was also able to transfer tumors from human patients into rabbits and guinea pigs.

This was one of the most confusing chapters of cancer research. Many interesting facts were introduced, but there were also many inaccurate and contradictory notions that soon fell into oblivion.

Transplanted cancer does not behave like spontaneous cancer. Spontaneous cancer, whether in man or animals, at first remains localized and grows slowly, until gradually it attains a considerable size. Then it ulcerates and eventually gives rise to secondary tumors throughout the body. Transplanted cancer, on the other

hand, remains localized and grows very rapidly. A transplanted cancer will reach an enormous size in a few weeks, becoming as large or even larger than the host that bears it. At this stage the host dies, usually without metastases having occurred. While these tumors do not ordinarily produce metastases, their cells do spread through the body. This is proved in two ways: first, microscopic evidence of malignant cells in the capillaries of the lungs or spleen, and secondly, fragments of these organs transplanted into other animals often give rise to tumors.

Clunet found by experimentation that the appearance of metastases could be provoked by extirpation of a transplanted tumor. This method has its counterpart in man for every surgeon knows that the removal of a malignant neoplasm may be followed after a brief interval by a sudden and fatal eruption of metastases in the internal organs.

Since the penetration of cancer cells into the blood and lymph vessels and their consequent dissemination are accidents that occur very early in the evolution of a malignant growth, it might be expected that secondary deposits would make their appearance as soon as a cancer is well established, and certain neoplasms do, in fact, behave in this way. Such tumors are rare, however, and most malignant tumors metastasize much later, indeed some do not metastasize for years. The assumption is that cells emigrating from these tumors into the surrounding tissues are killed off or at least lie dormant.

The problem of metastasis is one of the most urgent of all those associated with cancer, from a practical as well as a theoretical standpoint. The existence of latent carcinosis without actual metastasis indicates that under certain circumstances the body can prohibit the growth of cancer cells that have invaded its tissues. Realizing this, we may justly hope that once these conditions are thoroughly understood they can be reproduced at will.

In the endless search for something to influence the course of cancer transplanted tumors have been almost exclusively employed. Thousands of experiments have been performed in the last fifty years, but the net result has been inconclusive, if not actually contradictory, and extremely disappointing. None of the information thus laboriously acquired could be applied to man because his spontaneous neoplasms would resist any measures that might be found effective against transplantable tumors.

The transplantable neoplasm failed because it could throw no light on the cause of cancer. Thus it became increasingly clear that any advance was contingent on the discovery of some way to start

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way and Cook at the Royal Cancer Hospital in London discovered that pure synthetic 1, 2, 5, 6-dibenzanthracene possesses marked carcinogenic activity.

In 1933 Wieland and Dane effected the stepwise degradation of desoxycholic acid, one of the normal constituents of human bile, into an aromatic hydrocarbon designated as methylcholanthrene. Cook soon adduced completing evidence of the structure, and reported that the hydrocarbon is a very potent carcinogen (1934). Methylcholanthrene has been produced by an unusual and little understood pyrolytic degradation of a derivative of cholesterol, a substance present in all the tissues of the human body. The bile acids and cholesterol belong to the general group of steroid substances which also includes hormones secreted by the gonads and the adrenal cortex. The fact that three steroids present in the organism have been transformed into an actively carcinogenic substance suggests the possibility that comparable processes may occur in the body and that a sterol, bile acid, sex hormone or adrenal cortical hormone may be degraded through a process of abnormal metabolism to a substance capable of initiating cancer. There is no evidence that such a process can occur in the organism. On the other hand, no available evidence excludes the possibility that this may be the cause of some forms of cancer.

Another line of research in the attempt to determine the etiology of cancer concerns heredity. The most logical theory as to how cancer could be inherited is the "plasmagene" theory. Sonneborn uses the term "plasmagene" to signify any gene-like determiners that are located in the cytoplasm, and this term seems to be gaining favor in recent literature.

By reviewing the gene in the classical concept and analyzing the results of certain experiments, it is evident that all of heredity cannot be attributed to the action of chromosomal genes. The extranuclear factors of heredity have been termed plasmagenes. In certain experiments with various plants and animals some of the properties of plasmagenes have been determined. By assuming that plasmagenes exist and operate in higher animals as they do in more primitive plants and animals an attempt is made to explain the nature of the origin of tumors and cell differentiation. The explanation is based on the assumption that the five following principles operate in the functioning of cells in higher animals: (1) Factors in the cytoplasm or in the cell's environment may destroy or inhibit the production of a plasmagene or plasmagenes. (2) The rate of cell fission is controlled by a plasmagene or plasmagenes. (3) Plasmagenes are produced at a rate that is independent

cancer in an animal at any desired site and by a relatively simple procedure that could be applied on a large scale.

The *x*-ray was discovered by Wilhelm Conrad Roentgen in 1865. Many persons were injured by the rays before their true nature was discovered It was observed that if tissue were exposed to *x*-ray for long periods of time cancer would develop. Malignant lymphomas and various ovarian tumors have been produced in mice by exposing them to *x*-ray.

Cancer research has been greatly influenced in the last two decades by the discovery of a series of agents which enable us to produce cancer artificially. The discovery of the carcinogenic action, first of tar and subsequently of pure and simple chemical products, was the beginning of a new era in cancer research. The skin changes leading up to and terminating with the formation of a malignant tumor are microscopically characterized by a gradual development.

Microscopic examination of the lesions produced by tar has furnished information that never could have been provided by the tumors of man. This is especially true for the initial stages of cancer, for in the human subject one always arrives either too soon or too late, too soon as concerns a lesion in which cancer has not yet declared itself, for there is no way of deciding whether or not it ever will become malignant; too late when the diagnosis of malignancy is certain, for then the initial stage has passed by. With tar cancer, however, it is possible to follow every step of a process whose end is known in advance.

Case hardened adherents of the irritation hypothesis could see in tar merely a common irritant, with no specific character whatsoever, that incites the malignant change only because its repeated application sets up chronic irritation.

The newer work on carcinogenic agents has shown that some of the most active are the least irritative. We have come to think of all irritants as cancer producing. This assumption has been shown to be false. The degree of irritation and the ability to produce cancer are not necessarily proportional. So, although we do find certain customs, such as pipe smoking, associated with certain types of cancer, we cannot transfer those conclusions to other forms of cancer and assume that all cancer is produced by an irritant.

The discovery that certain polynuclear hydrocarbons have carcinogenic activity opened a vast field for the investigation of the cause and control of cancer. The production of cancer in experimental animals by the use of a specific coal-tar fraction was achieved by Yamagiwa and Ichikawa in 1915, and in 1930 Kenna-

In America alone during the year 1948, approximately $31,000,000 was spent on cancer control. The source of this money was the federal government – $14,000,000, the American Cancer Society – $12,000,000, and state governments, universities, and other groups – $5,500,000. It was allocated in the following manner: $14,000,000 was spent for research, and the remainder was used for educational repoıting, clinical facilities, epidemiological studies, and the care of the hopelessly ill.

From the above financial report it is seen that the United States government is at present the backbone of the fight against cancer in this country. It functions under the title of the National Cancer Institute, located at Bethesda, Maryland, and is manned by the United States Public Health Service. This federal agency was created by Congress in 1937. So typical of the overall cancer project is its method of procedure that it might be well to consider closely its organization.

All funds are placed under the control of a committee which studies the numerous problems to be confronted and finally decides on an allotment scheme. Today the following projects are receiving government money: Research at the Cancer Institute in Bethesda, Maryland; research grants and fellowships to various colleges and individuals; cancer control activities by state health agencies; certain special control programs; improvement of courses in cancer in medical and dental schools; demonstrations; consultations; advisory service; and administration and laboratory maintenance.

Activities at the Bethesda, Maryland, center present a smooth working machine. Staffed by some of the leading scientists of America engaged in a full time service, it is attacking the problem both collectively and individually. There are specialists in pathology, biology, endocrinology, surgery, chemistry, radiophysics, and chemotherapy. They are all grouped separately for administrative convenience. This also allows the study of intricate details. On the other hand, these same workers collaborate their efforts and findings to gain an overall picture, thus preventing the scientific pitfall of a single line of thought.

The role of the American Cancer Society must not be overlooked in an evaluation of the foundations for cancer research in America. This organization has been the foremost leader in the drive to make America cancer conscious. It was founded in May, 1913, under the name of American Society for the Control of Cancer. This was later shortened in July, 1944, to American Cancer Society, Inc. Its membership is based on the democratic principle, and there are divisional headquarters in all of the states, the District of Colum-

of cell division. (4) The expression of a plasmagene depends on its concentration in the cell and these expressions are responsible for cell differentiation and maturation. (5) Genes cannot initiate the formation of certain plasmagenes.

By making the above assumption, the manner of cancer formation may be explained. All of the carcinogenic agents, including virus, exert their influence either by destroying or inhibiting the plasmagene or plasmagenes that control the fission rate of cells.

The alteration of a normal cell into a cancer cell involves a loss of differentiation. In a given cancer, the cells may be placed in a sequence from a near normal differentiated cell to a cell that approaches the embryonic type. The loss of differentiation is associated with an increase in fission rate of the cancer cells. The uniformity of the cell in an area of cancer, cannot be explained by the extremely variable chromosomes. This suggests a cytoplasmic factor and may be due to a dilution of the plasmagenes.

Another theory is that some or all cancers are caused by viruses. The etiological agent, as it is found in tumor filtrates, shows many analogies with the viruses. Yet it possesses some properties that distinguish it from these and have continued to excite the interest of investigators for many years. For example, filtrates are not uniformly active, and tolerate high dilution badly. The explanation for this has been furnished by Claude, who showed that the agent is absorbed on the proteins of the extracts and exposed to the influence of an inhibitory substance that is always present in large quantities in the serum of sarcoma-bearing fowls.

Injection of this agent into a foreign species, such as the rabbit, excites the production of antibodies that neutralize the sarcomatogenic properties of filtrates, and with such an antiserum chickens can be immunized against the virus. But those chickens protected in this way against filtrates are nevertheless receptive to tumor grafts. The virus, secure in the cells of the sarcoma, is beyond the reach of the antiserum, and this is the reason, too, why the injection of an immunizing serum is without any effect upon a tumor that is already established.

Possibly the greatest impetus in the search for new knowledge on cancer has been given by the various foundations of research in this country and in other nations of the world. It was soon learned that the task was too great for any one individual both from a financial and intellectual point of view. Groups were formed by the general public, federal and state governments, and privately endowed clinics until today there are many recognized societies working for the elimination of this disease.

little of their national set-up is known. In the American Review of Soviet Medicine, articles are published which deal with the formation of cancer cells.

An effort is being made today, however, to pool the knowledge of the world in order to reach more definite conclusions. Heading this task is the International Cancer Research Commission. It represents an organization of 45 countries who meet each year in different countries with alternating representatives for a discussion of the entire cancer problem. In July, 1950, this group met in Paris, France, for five days. Topics ranged from laboratory experimentation reports to the social economic status of cancer. Publications, complete with charts, photographs and drawings of all business and papers presented were made in English, Spanish, Russian, German, French, and Italian. Also another progress in this program has been fostered by the American Cancer Society in cooperation with the British Empire. It has great possibility of a closer union of effort by the countries of the world. This is the British-American exchange of students in cancer research. It is designed for the broader training of individuals launching on a career of clinical as well as experimental cancer work. Representatives from this country must hold a degree of Doctor of Medicine, Philosophy, or Science.

Although there has not been found yet a definite cure for cancer, the work of these various groups has not been in vain. A few of their most recent and important conclusions are shown in the following paragraphs.

A review of the proceedings of the various departments in the National Cancer Institute at Bethesda, Maryland, will give a summary of the present methods of attack and bring one up to date on the cancer approach. From a biological view-point the study of cancer is being carried out on the lower forms of life as bacteria and paramecia. It is thought that these one-celled animals react as an individual cell of the human body when carcinogenic agents come in contact with the body. Also cancer cells are planted between glass plates in the skin of live mice thus allowing close microscopic examination of these and surrounding cells under the various lens.

Experimental work was initiated by the pathologists. They carried out morphological and transplatation descriptions, thus proving that cancer is an aberration of the cell and that mammalian cancer can be transmitted only by transplantation of the cell. Their interest has been founded mostly in the discovery of the etiology of cancer. It was Peyton Rous who demonstrated the transfer of cancer be-

bia, and many of the larger counties and cities. Representatives are elected from each of these offices to serve on a board of directors. This group meets every three months. Its executive committee is in session each month that the board does not meet.

During its infancy financial aid was a problem since it depends on the American public for support. Up until 1937 no more than $400,000 was available annually for the entire cancer fight. However, through various publicity procedures, such as National Cancer Month, and the aid of outstanding figures of the entertainment and business field, money is now a minor problem in securing a complete coverage of their vast program of collecting, collating, and disseminating information on virtually every subject of cancer, of organizing and administrating the Woman's Field Army, of aiding indigent patients and assisting in the establishment and operation of clinics and hospitals for the treatment of all carcinogenic patients. Further the society's interest in research is shown by its appropriation during the fiscal year of 1947-48 of $3,500,000 to this through the National Research Council, National Academy of Science, its advisory agent for research. The council formed a Committee of Growth which consists of 120 of the foremost research men of the nation.

Also noteworthy in the cancer fight in America are the smaller groups which have been made possible by schools, hospitals, and philanthropic individuals. Their work is so similar to the above two groups that only their names will be given. A few of the most outstanding follow:

Crocker Fund and Rockefeller Institute, New York, N. Y.
Jane Coffin Child Memorial Fund for Medical Research, New Haven, Conn.
Harvard Medical School, Boston, Mass
Finney Howell Research Foundation, Inc , Baltimore, Md.
University of Michigan – Kellogg Foundation, Ann Arbor, Mich.
Yale University School of Medicine, New Haven, Conn.
The Rhode Island Foundation

America is not alone in the battle against cancer. Great Britain and Canada have groups similar to those in the United States. In England there are the Imperial Cancer Research in London, the Cancer Hospital of London, and the Radium Institute of London. Canada has two national organizations: the Canadian Cancer Society, begun in 1938, and the National Cancer Institute, founded in 1947. Other work in this field is going on back of the "Iron Curtain"; but as with all other information in that section of Europe,

and never does it demonstrate itself as a single cell entity. It is possible that cancer is inherited, but never has it been classified as an infectious disease.

Still lacking, however, is a definite cure-all for cancer. This will probably not be discovered until the actual etiology and mechanism of tumor formation are known. All treatments thus far have been on a hit and miss basis. Scientists are now tracing down all leads on new information in cancer cell physiology and biology with the hope of possibly some day arriving at a cure.

Some attempt at cancer therapy has been made and today authorities recognize three, and possibly four, procedures. These are surgery, x-ray, and radium therapy. The use of antiserums, antibiotics, chemicals, tissue extracts, and hormones have not yet proved of sufficient value for authoritative consideration. Radium is not as penetrating as the x-ray so therefore may be used within the body whereas more care must be employed with the roentgen dosage as actual tissue destruction of surrounding structures is most likely to occur. Thus one sees the value of a thorough study of both these elements before attempting their use. Radiation has not been found valuable in the treatment of carcinoma of the esophagus, stomach, large intestine, and lungs. Surgical technic also requires skill in that all of the carcinogenic tissue must be removed or recurrence will appear. It is for this reason that surgery is performed on a radical basis in both the young and the old. All of these treatments should be undertaken during the infancy of the growth. Therefore special consideration must be given to early recognition. Some authorities believe that if the causative agent is removed early enough, especially in the precancerous lesion, leukoplakia, that the above three treatments will not be necessary. More study and clinical observation is needed though to determine these etiological agents.

Thus the problem of total cancer eradication is still with the people of the world. The groundwork of a true scientific program of study has been laid down, however, and it now remains for the future workers in the field to produce the end result.

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tween animals by filtrate injection from a sarcoma believed to be due to a carcinogenic virus.

The department of chemistry has a two-fold task of both etiology and treatment. Since it is known that cancer cells differ greatly from normal tissue, the chemical contents of numerous specimens have been thoroughly analyzed to determine if too much of a substance has been added to the body or vice versa. Some of the chemicals definitely found to be causative agents of cancer are arsenic, nickel carbonyl, benzol, radium, asbestos, and chromate. In an attempt to find a palliative or cure for cancer, about 5,000 substances have been tested. Included in the number were the arsenicals, vitamins, sulfonamides, and antibiotics.

As with other scientific fields, the function of the endocrine glands has been considered in cancer today. Very favorable results have been obtained from hormone administration in cancer of the prostate and breast. However, Haagensen considers this not a curative treatment but only a comforting agent.

Radiophysics offers great prospects in the control of cancer. Although this is a new field it is recognized that radiation has a causative as well as fatal effect on cancer cells. Not only does the former factor serve as a protective during cancer work but serves as a source of experimental causation of cancer. Certain lymphomas and ovarian tumors have been produced in rats by overexposure of roentgens. A study was made at Oak Ridge, Tennessee, of the effect of occupational radiation. It was found that unless an over dosage was received, those working with radiatized materials did not appear more susceptible to malignancy than people connected with other fields of endeavor.

Most notable of the research findings which have been presented to the public in the last decade are the change in viruses after passage through young and alien hosts, studies on milk and light factors as excitive agents, malignancy production *in vitro*, the production of cancer by intrinsic chemicals present in experimental animals, cancer control by hormone injection, and Greene's heterotransplantation of cancer cells for a proof of the carcinogenic activity. These are explained in other sections of this chapter.

Also by the way of summary, the only definite conclusions which one may so far draw from all combined efforts are seemingly not complete but they do offer a basis for further observation and should not be ignored. Cancer cells arise from normal cells with no sharp line of demarcation between these, and many species of animals are affected. The cells themselves are not organized and have no nerve supply or supportive stroma. It may have many exciting causes

3

Diagnosis and Treatment Planning

In beginning the study of this chapter on diagnosis and treatment planning, perhaps it would be well to delve a bit into the psychological aspect of handling our patient. Psychology is a study of human behavior. It should be used to a great advantage while examining the patient. In short, it should provide the doctor with facts which control that which is termed human nature. Knowing these factors, the doctor may then successfully orient himself to these conditions as he meets them in his everyday practice.

In view of the fact that the first acquaintance of the examiner with the patient occurs in the consultation room, we shall discuss the psychological effect that may be induced upon the patient. The surroundings should be pleasant. The color scheme of the room should be compatible, the furniture carefully arranged and neatly kept, especially the doctor's desk. If there is a window in the room the light should always be at the doctor's back or side, never in his face. The patient may have the light in his face or at his side. The light in the doctor's face gives him a psychological disadvantage.

In modernizing the office lighting, one problem is the light intensity. Glare and shadows must also be considered a problem. These three problems can be overcome by proper diffusion. A new lamp shade or a new lamp occasionally breaks the monotony of the sameness and enhances the beauty and comfort of the office.

The reception room should also be well ventilated. The furniture doesn't have to be expensive and elaborate, but it should be well arranged and well kept. The reception room should be located in such a manner that conversation and noises which arise in the operating room will be excluded either by distance or by rendering the room sound-proof.

The next factor which will have an effect upon the patient is that of professional dress. In modern advertising, the doctor is always shown wearing a neat white jacket or uniform. This form of dress in the opinion of the patient denotes honor and respect. The dentist, surgeon and physician will find it to their advantage to wear all white, since this uniform is indicative of the

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so much that in most cases the level of conscious intention is not reached and the head and hand are kept immobile. However, there are two cases in which the above statement is not true.

In the first case, the impulse is no stronger than usual; however, the inhibition is weaker. Either the patient has never been taught or he is psychologically unable to inhibit his impulses. All other things being equal the patient who has been properly reared will be the easier of the two to work with.

The hysterical personality, however, may have had proper training but be incapable of practicing what he knows is right. This behavior is due to the fact that it is less important to behave properly than to protect himself in pain and impress upon the dentist that he is dealing with an important and delicate organism or to attract attention.

In the second case we are dealing with individuals who have strong or slightly stronger inhibitions than the average, but have stronger impulses than the average. That is to say they are constitutionally more apprehensive than most people. This type of patient is aware of the fact that he should behave and he tries to do so; however, he is overwhelmed by apprehension through no fault of his own.

Secondarily the apprehension of pain depends upon certain specific conditions. In all of us, there exist the germs of certain mental attitudes of which existence we may be quite unaware normally. There are two attitudes which play a prominent part in apprehensiveness in the dental chair. They are the fear of points and the awe of machinery and of energy emanating from an invisible source. These two attitudes are displayed by every person to different degrees. In persons that have been predisposed, these attitudes may even emerge as full-blown mental symptoms. The fear of points in its most florid intensity may appear as a pathologic fear of sharpness to the extent that even the sight of a sharp object or anything associated with incision may cause an intense panic and agitation which results in an impulse to flee or destroy the offending object. A pathologic awe of machinery and invisible energy is a frequent element of paranoid conditions. In this case, for no apparent reason, the individual senses on all sides mysterious machines from which energy emanates to destroy or influence him. Any germ of the fear mentioned in the above is stimulated to activity in the dental chair and this may profoundly affect his conduct there. The sensitivity of the patient is enormously enhanced due to the fact that he knows that his tissues are actually going to be penetrated by the instru-

doctor; likewise, the assistants should dress in white uniforms, preferably with long sleeves.

It is good psychology for the operator to keep his hands free from calluses, chafes, and abrasions. The fingernails should always be cleaned, closely filed and never permitted to grow more than one or two millimeters. When preparing for an examination the hands and part of the forearms should be thoroughly scrubbed. The scrubbing should be done in full view of the patient so that he can see that the operator's intention is that of cleanliness and asepsis as much as possible.

Since most of the patient's time is spent in the examining or treatment room the psychological aspect of it as well as that of the reception room and consultation office must be considered.

This room should have as few instruments as possible displayed to the view of the patient. To the doctor, these instruments are jewels or works of mechanical art, however, to the patient they are only reminders that he is facing an unpleasant ordeal which is likely to produce some pain.

Before discussing the importance of preventing pain by various psychological procedures, it would be well to explain the various means by which the impulse of pain is experienced by different individuals and their reaction to these stimuli.

Pain is one of the most important problems which faces the doctor This factor usually is the predominant reason which directs the patient to this visit. Also, it will tend to keep the patient away from him

Pain is defined as the interpretation of some abnormal and generally harmful process which is occurring in the organism.

Every doctor must have certain attributes which help him to gain the confidence of his patients. This is the first step in the alleviation of the fear of pain. In the minds of the public the word "pain" is synonymous with the dentist principally, but also with all forms of medical treatment. The problem of the doctor is to treat the patient without causing more pain than has already been instigated.

The apprehension of pain depends primarily on general conditions. For instance, when a sharp instrument is placed in the mouth of a patient, especially when its potential painfulness has been previously proven by experience, there is an immediate impulse to avoid such.

In all individuals there is a universal impulse to avoid the threat of an instrument either by destroying the agent who wields it, or by flight from it. Usually, the individual inhibits this impulse

It is claimed by many eminent psychologists that an individual fundamental conception of ethics is established before a person reaches the teen age. If this is true, a discussion of the subject from a strictly moral standpoint would be a waste of time. But aside from that, honesty is a plain, cold business asset.

It is well to heed the advice of Polonius who spoke to his son: "This above all, to thine own self be true, and it must follow as the night the day that thou cans't not then be false to any man".

Other factors can be considered concerning conversing with the patient. All the attempts to influence the patient result in failure unless the surgeon uses words which the patient can understand. The use of scientific words is all right among men of the same profession. However, they should be avoided when talking to the lay patient. If they are used when talking to the patient, he will seldom admit that he does not understand, and instead of asking for an explanation, he will reason it out his own way and may arrive at an undesirable conclusion.

Also the use of certain lay terms should be avoided, such as, cut, slice, grind, hemorrhage, break and shot. When the surgeon uses the word cut, the patient immediately thinks of cutting his finger with a sharp knife. This reminds him of some past experience of pain. The word hemorrhage implies that the patient is bleeding to death. To the layman this word is misconceived and his condition is often thought by him to be severe when only minor bleeding may be present and of no consequence. The word shot should never be used to imply the injection of an anesthetic or other drug such as penicillin. The patient thinks immediately of some dreaded experience which he has had from a needle previously.

It should be realized that use of the correct word at the right time may often solve seemingly impossible problems. Joseph Conrad, the English novelist, once was asked how he made his living; his reply was, "I am a dealer in words and words are, of course, the most powerful drug used by mankind. Give me the right word and the right accent and I will move the world".

Last but not least concerning the use of psychology in examining the patient are the psychological factors of financial arrangements. This has much to do with the successful practice of the doctor. Often the patient has expressed his desire to have any advised procedure performed on him. The next step is the frank discussion of financial arrangements.

The assistant or receptionist should be well trained to handle this part with diplomacy and therefore avoid needless loss of the doctor's time. The doctor has a right to know how and when he

ment. Also he is aware of the fact that the mysterious vibrating energy is actually going to be applied to him. It would be a triumph of civilization if the patient could sit still in the face of his strong conscious or unconscious resistance and let the operator proceed with the operation.

The apprehension of pain when revealed to the surgeon interferes with his work in gross or subtle ways. In the event that the patient has primordial impulses of complete self protection he might withdraw from the instrument or in rare cases, he might assault the surgeon.

Also it is of inconvenience to the operator for the patient to exercise some restraint, but give motor expression to his protective impulses directly. This is done by threshing or jerking or simply moving his arms, legs or body—motions not directly concerned with the withdrawal of the mouth or the removal of the instruments from the mouth. A person who is able to inhibit all voluntary motor activity, but cannot inhibit his autonomic nervous system, is a stage higher than apprehensive patients. He manifests his apprehensiveness by the spurting of saliva and interfering with the operation. The most accommodating of apprehensive patients are those who are able to inhibit both motor and secretory activity and simply experience apprehension without exhibiting external evidence.

In dependent people, especially women, often the feeling of "being taken care of by a strong competent individual" upon whom they can lean emotionally outweighs the fear of pain. In this case apprehension and tension are almost completely absent. The actual perception of pain depends on the individual susceptibility. The operator, in practice, is more interested in how much the patient reacts to pain than how much pain he experiences. This not only includes immediate reactions such as moving, jumping, jerking, etc., but he is also interested in long range reactions such as the patient's going to another doctor who has hurt him less.

One may ask how the doctor can reduce the apprehension of pain and the amount of pain felt by the patient and thus minimize the psychomotor reaction and the psychobiological reactions which tend to upset both doctor and patient.

The doctor who has psychologic intuition can obtain better results from his patient than the man who is merely a technician

The psychology of talking to the patient is a very beneficial one. One of the first rules to be followed in communing with the patient is, "Tell the truth". Do not tell the patient that he will not feel pain when it is known that this is not so.

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will be paid and the patient has a right to know what he is spending and how he may pay it. This avoids possible later misunderstandings.

Usually, the first step toward an examination is to get the pertinent facts about the patient as to name, age, sex, occupation, previous illnesses, general health, physical condition and chief complaint. A record is then made as to the presence or absence of teeth; size and type of present fillings, crowns, bridges and dentures; decayed teeth, pulpless teeth, malposed teeth; conditions of the surrounding tissues; tonsils, lesions and periodontal pockets. This is usually the extent of the dental examination of the patient and rarely does the dentist get this far successfully in his attempt toward a proper examination and case history. There are two principal reasons for the examination ending at this point. First, the patient usually comes to the dentist for relief of pain. He cannot clearly understand the value of the many questions asked of him about apparently unrelated conditions in which he is not in the least interested. If the pain is relieved, the patient is satisfied to leave the office and in many cases not to return until he needs relief once more. The second reason for a casual examination is usually the question of fees. Quite naturally a substantial fee must be expected from the patient for a complete examination involving both time and knowledge of the doctor. Many patients hesitate to submit to a complete examination because of the intangible benefit derived from such. The financial condition of the patient plus the cost of the examination hinders both the doctor and the patient because of sufficient lack of knowledge of the situation and conditions at hand.

Certainly it is true that the public is becoming more and more aware of the need for proper care of the mouth, yet this care can scarcely be given if a proper examination is not effected.

The general physical condition of the patient is one of the first things to be observed by the alert doctor in the beginning of the oral examination of the patient. Many characteristics may be noted at a glance such as the gait of the individual, color and texture of the skin, the general condition of personal hygiene exhibited and many other significant facts, all of which are important, no matter how trivial they may seem. The facts gained in obtaining a short history and physical examination are not only of value to the operator, but the best interests of the patient are being taken into consideration, because *it is the well-being of the patient* who is entrusting himself into the hands of the doctor that the examiner is to preserve.

The answers to a few well-directed questions will enlighten the doctor tremendously as to the present condition of the patient and will, if necessary, enable him to suggest further physical examination by a specialist if the findings so warrant it. Some important information needed at the onset of the examination is whether the patient is at present under the care of a physician; whether he has a serious illness at the time; any information as to previous operations that have been performed and the rate and type of recovery. Answers to these questions contain a wealth of information if justly considered. Questioning may reveal that the patient is a diabetic; if this is the case, the doctor should be certain that the patient is under control. Failing to do this may cause untoward reactions or healing, for example, with the extraction of teeth. The examiner may find also that he is dealing with a person who has been afflicted with rheumatic fever, in which case premedication is a necessity if any surgery is to be attempted. Cardiac conditions may appear, at which time it would be necessary for the patient to have a complete physical examination to determine his ability to undergo the type of operation in question.

Questions as to previous operations may reveal possible blood dyscrasias or abnormal bleeding, these being important if surgery is indicated in later procedures. Facts may be gained by observation such as cachexia, labored breathing and cyanosis, each of which has a meaning such as malnutrition, heart disease and other physical disabilities which are to be taken into consideration.

Assimilation and correct interpretation of the facts gained by questioning and by direct observation will greatly enlighten the operator; therefore the smallest bit of information should not go without due consideration. Many important points are available to the examiner if he will utilize the knowledge that he possesses and apply that knowledge to the patient being examined. One should also keep in mind that the color of the skin and hair of the individual may be an index upon which to judge the possible reactions to an anesthetic. It has been reported that patients with red hair are more sensitive to procaine than are darker individuals. This seemingly insignificant observation may prepare the prospective operator for a situation that might otherwise be dangerous, or to say the least, embarrassing. The greater abundance of knowledge the doctor has of the patient, the better he will be able to administer properly to that patient.

The chief complaint of the patient is usually given voluntarily and often is explained to great lengths; however, it may be written in just a few words on the examination sheet for future reference

or information. The examiner should allow the patient to talk freely and describe in his own way the condition which prompted him to seek the services of the dentist or physician. Careful attention to the way the patient described his complaint will usually contain a wealth of knowledge which, if used to its greatest advantage, will aid in a correct diagnosis accompanied necessarily by a clinical examination. Some patients have the tendency to describe in too much detail and length their pain and at the same time give little information of value to the doctor. Care must be taken, however, to correctly evaluate the information gained in order that some important conditions described by the patient may not be deleted from the examination. Often some very obscure condition, symptom, or facts may be described by the patient and this makes it difficult at times to arrive at their importance. Many times the conditions described are not visible to the eye and intelligent methods of deduction must be used in order to arrive at the cause of their existence. For example, patients may present themselves with pains in the joints, shoulders, wrists or fingers, muscle pains in the neck, shoulders or back of the head; disturbances of the sinuses, eyes, ears, heart and kidneys. All of these abnormal conditions may be associated with disturbances of the teeth, tonsils, sinuses or mucous membranes of the mouth. It is the task of the doctor to correlate these symptoms with the findings of the clinical examination.

The ambulatory sick patient has a tendency to go into detail too much, however, carefully worded and deft questions by the dentist or physician may help to eliminate all superfluous information gained from the patient and to concentrate all facts pertaining directly to the case at hand. This questioning interspersed with the patient's description of his complaint may bring out salient information that might not otherwise be gained because of the little value it may have in the mind of the patient. After listening attentively to the patient's complaint the same should be retold to him in order to clarify any parts that he may have vaguely discussed and to briefly summarize the accumulated facts in order that the essentials of the case may be clearly and definitely fixed in the mind of the examiner.

There are many facial signs which are of interest and which should be included in the oral examination. This information may be obtained at a glance and usually very little questioning is necessary. The color of the face should be noted carefully as has been stated before; persons with fair complexion may be

susceptible to toxic manifestations of procaine, which is indeed of much interest and importance particularly to the dentist. Pallor, blueness or undue ruddiness of the complexion should be taken into consideration because of its possible connection with blood dyscrasias. Mouth breathers may lead the dentist in some cases to suspect diseased adenoids. The contour of the eyes in relation to the face is also important in that exophthalmic goiter may be the cause of protruding eye balls. Abnormal facial expressions may also be caused by tuberculosis, alcoholism and other diseases.

Displacement of parts of the face may be due to previous fractures or wounds which may have a history that is related in some way to the individual's present complaint.

In considering the face we must also examine the lips. This examination should include both the cutaneous and mucous portions of the lips and also the commissures of the mouth. This may reveal a harelip or an operation that has closed the cleft. Hypertrophy of the lips may be a result of lip sucking or malocclusion; however the etiology may be determined by the actions of the patient. Constant licking of the lips by the individual may result in perlèche involving the buccal commissures of the mouth. The resulting fissuring, redness and slight exudation may cause pain when the patient attempts to open the mouth. This same type of lesion must be differentiated from the syphilitic lesion and a serology test may be indicated in some cases. Herpes simplex, aphthous ulcers and eczema are other lesions that may be commonly observed on the lips and be alarming enough to the patient to seek aid.

Cyanotic lips, if presented, may indicate a cardiac insufficiency. Small round movable bluish nodules on the mucous membrane portion of the lip may be due to cysts of the mucous glands. The size and extent of lesions on the lips should be noted to see if such lesions extend to the buccal mucous membrane.

By observing the face of the patient, lesions or diseases of the nerves may be noticeable. Paralysis of the face usually does not cover the entire face but is partial to the area supplied by the nerve in question. Lesions of the fifth nerve may not be very noticeable but the chin or the corner of the mouth may deviate to one side Paralysis of the facial nerve smooths the face and gives it an unnatural appearance, the extent and duration of this condition varies according to the cause and location of the disturbance

If paralysis of the second and third divisions of the trigeminal nerve exists the patient will have hypoesthesia, or anesthesia may

occur. This numbness and lack of sensation may be the after effects of an extraction, chronic infection or local anesthesia. The numbness usually does not last indefinitely and the length of time varies from a few days to a few months for regeneration of the nerve to occur, thus restoring sensation. Neuralgia of the face may be a complaint of the patient and it may be due to diseases such as diabetes, anemia, typhoid fever, diphtheria and nephritis. Local causes may also cause neuralgia by reflex irritations from the eyes, ears, teeth or trauma. Due to referred pain it may be difficult to determine the area of origin since any change may affect the nerve endings of the fifth nerve with the lesion anywhere along the course of the nerve. The most common causes of neuralgia of the second and third divisions of the fifth nerve are defective teeth and dental diseases. Other causes may be foreign bodies, injuries, respiration and systemic diseases that produce a change in the blood. If the patient has neuralgia he will usually complain of pain radiating from the supraorbital, infraorbital or mental regions. The pain is of an intermittent type, usually diffuse, and paroxysms may be brought on by touch or sudden changes of temperature on the face. Tic douloureux is an affectation of the trigeminal nerve which occurs usually in middle-aged and old persons. The pain is sharp and excruciating and may occur suddenly without warning. The patient often in later stages lives in constant fear of the next attack.

Other neuralgias which may confront the dentist are spheno-palatine neuralgia, glossopharyngeal neuralgia and superior laryngeal neuralgia.

Paralytic affections which are of interest to the examiner may be associated with the facial nerve, the trigeminal nerve or the hypoglossal nerve. Bell's palsy or facial paralysis may be due to trauma, tumor, infection or sudden exposure to cold. This is a paralysis of the facial nerve. Paralysis of the trigeminal nerve may affect the muscles of mastication, and the chin often deviates toward the paralyzed side when the mouth is open. Paralysis affecting the hypoglossal nerve may cause the tongue to deviate to one side if half of the tongue is affected, and if paralysis persists that side of the tongue will eventually shrink.

In the examination of the gingiva, the color, form, density and attachment to the necks of the teeth are all important. The color of the normal gingival tissues varies with each individual in different shades of pink, however, a uniform shade is characteristic of each individual. This color is produced by the amount and quality of the blood supply and is modified by the thickness of the epithel-

ium. Thus, in anemic and debilitated persons the color of the gingiva is usually a lighter shade of pink because of a decreased amount of blood in the peripheral circulation. The color of the gingiva, therefore, is in direct relation to the physical condition of the patient and both must be considered in the examination.

The form of the gingiva normally follows the cervical contour of the tooth and slightly overlaps the enamel. The interproximal spaces are completely filled to the point of contact between the adjacent teeth. Observation should be made as to swelling or hyperplasia of the gingiva and to shrinkage or recession. In the early stages of gingivitis there is an initial swelling which can be detected from normal. Recession of the gingiva may be due to degenerative changes or to injury. Inspection should be made especially in the lower anterior labial portions of the gingiva to determine the presence of "Stillman's clefts", which is a definite sign of occlusal trauma.

The density of the gingiva is normally hard and firm because of its attachment to dense underlying connective tissue and the alveolar process. Soft spongy gingival tissue may indicate a chronic inflammation, whereas a smooth glistening gingiva indicates edematous or inflammatory conditions of the submucosa.

The gingiva is attached around each tooth at the gingival sulcus by fibers connecting with the periodontal membrane. This gingival sulcus is usually shallow, and deepening of the sulcus is indication of periodontal disease. Therefore, not only must visual inspection of the gingiva be made but also palpation and exploration should be carried out carefully in order to determine its condition.

The mucous membrane of the oral cavity deserves careful consideration in the examination in that it has many functions and is constantly exposed to mechanical influences such as mastication of rough hard food; consequently its structure varies in different areas of the mouth. The mucous membrane referred to in this instance is the entire lining of the oral cavity. That which immediately covers the alveolar processes and surrounds the necks of the teeth is referred to as the gingiva. This is different in texture from the remaining portion and is tightly adherent to its underlying structures. This difference in structure and attachment of the mucous membrane to the submucosa has a practical significance. In the areas of loose attachment of the mucous membrane large swellings can occur due to edema or hemorrhage and in these areas it is easy for infections to spread rapidly and to extend into other areas. With this loose attachment swellings are not usually painful, but

in areas of rather firm attachment such as on the palate, swellings may cause much pain.

Normally, the mucous membrane is varying shades of pink due to the nearness of the blood vessels to the surface. The moist shiny appearance given to it is due in part to the many small mucous glands distributed throughout the mucous membrane.

Lesions of the mucous membrane of the mouth often present themselves and in many cases are difficult to properly and correctly diagnose.

Due to the fact that the mucous membranes are constantly exposed to trauma caused by foods and stresses of mastication, to bacteria which are always present in large numbers, and to the various wide changes in temperature due to ingested food and drink, lesions in the mouth may present an entirely different clinical picture from that normally expected. Lesions of the mucous membranes may be classified on an etiological basis such as local, focal and toxic causes or they may be due to constitutional diseases, new growths both benign and malignant, congenital malformations and diseases of unknown etiology such as pemphigus, lichen planus and others.

Lesions of the mucous membranes may be due to conditions in the mouth such as abscessed teeth or sinus infection. These may range from simple swellings to severe ulcerations. Mycotic infections, perlèche and actinomycosis may also come under this type of lesions due to focal causes.

Lesions due to toxic causes are many, and careful history taking and a good working knowledge of the different lesions of the oral cavity are necessary for a diagnosis. In the examination, lesions such as herpes simplex, certain drug reactions, allergies and rashes may be seen.

Early detection of certain diseases may be made by the examiner by recognizing certain signs that are manifested on the mucous membranes. One of these of importance is Koplik's spots which is a diagnostic sign of measles before the rash occurs. The lesions of syphilis in its various stages often manifest themselves on the mucous membranes. Leukoplakia is frequently seen on the buccal mucosa, more often in men than in women, and is important in that it is considered a precancerous lesion.

A careful examination may reveal to the doctor oral manifestations of diseases of the blood forming organs or blood dyscrasias. Diffuse petechial hemorrhages may be an early sign of leukemia. Agranulocytopenia may often present lesions on the mucous

membranes as deep ulcerations covered with a diphtheritic membrane.

To facilitate the examination of the tongue and the floor of the mouth, wooden tongue blades or the dental mouth mirror are very helpful. Good exposure of the surfaces of the tongue is necessary in examining carefully the sublingual space and the margins of the tongue. In examining the floor of the mouth, resistance of the tongue may be overcome by having the patient place the tip of the tongue in the opposite cheek and, aided by pressure of the tongue blade or mirror, the surfaces may be exposed. Often, it is of advantage to the operator to grasp the tip of the tongue with a piece of gauze between the finger and thumb and use the tongue blade in conjunction to help overcome a powerful muscular organ. In the dental practice, examination of the tongue is usually limited to the anterior two-thirds, if further examination is to be conducted, normal positions of the patient in the chair must be changed and a more upright posture assumed by the patient so that the tonsils, fauces, uvula and soft palate may be more clearly observed. During the examination of the tongue, gagging may be prevented by holding the tongue on its margins with the tongue blade and pushing it from side to side to obtain the desired positions. Palpation of the tongue and floor of the mouth seems to be one part of the examination that is too often overlooked during the examination. If any painful areas in the floor of the mouth or in the tongue exist this palpation will reveal their location to the operator quickly, whereas without the digital examination, hidden cysts, indurations or chronic abscesses may escape detection by the examiner. When a definite lesion is located, palpation will reveal much to the dentist as to the size, consistency, location, sensitivity and relation of the lesion to other structures

Symptoms of pathology may be frequently detected on the tongue. Observation may reveal deformities such as cleft tongue, shortened frenum or tied tongue, or macroglossia. Wide tongues may be fissured. Tuberculosis, syphilis and cancer may also be manifested by fissures. Gastrointestinal upsets may be recognized by recurrent inflammation, smooth red sore tongue or a thickly coated tongue. Debilitated patients may exhibit geographic tongue or erythema migrans which starts as small red patches and spreads as irregular rings with sharply defined yellowish borders. These rings may extend around the margin of the tongue and onto the under surface. Anemic and neurotic women may exhibit glossodynia exfoliativa which may be observed easily by separating the papillae on the tongue and looking for red spots or streaks. Leukoplakia

may often be seen on the tongue as white elevated patches of irregular outline which may be fissured. Swellings of the tongue may include lymphangioma, aneurysm, fibroma, lipoma, epithelioma and carcinoma.

McCollum states that, "A mouth without teeth cannot chew, without some teeth it may chew badly, but a mouth with a full complement of teeth may chew well and physiologically, or it may chew well but pathologically; that is, the parts may be badly related".

In the examination of the hard structure of the oral cavity the above stated is a good thought to keep in mind. We must observe the functional as well as the structural aspects in our examination.

If this examination is the first one made by the dentist, the dentition both present and absent should be fully recorded. Then upon subsequent examinations the record card should be adjusted to show the dentition as it exists at that time. The occlusion of the teeth is noted on the first examination regardless of age and its condition. This can be made by the use of Angle's classification of malocclusion. To further our data for making a functional diagnosis, it is necessary to have a structural recording by means of study models properly mounted on a good articulator. Here we can observe the factors of articulation, the condition and relation of the teeth to each other in the same and opposing arch

The teeth should be examined in an orderly and systematic manner by the use of explorers, mouth mirror and a strong light. All visible carious lesions, abrasions, erosions, exposed cementum due to recession of the gingiva, open contacts, calculus and color should be carefully noted and recorded. Any departure from the normal in shape, position or arrangement should be noted, as this usually means diminished function.

A study of the proximal and occlusal contacts of the individual teeth should be made as this will most often reveal the cause of diseases of the investing tissues of the teeth.

A tooth that presents discoloration is not always an indication that something is wrong with the pulp but it should be suspicious until proven otherwise. Testing of the pulp can be made by several means. This is a valuable aid in diagnostic procedures. Probably the most satisfactory of these is the electrical pulp tester; however, this device is not infallible. It is based on the reaction observed when a weak electric current is passed through the tooth which reflects the sensory innervation of the tooth as compared to a sound vital tooth that is a complement to the tooth in question.

Percussion and palpation of the tooth is used many times in diagnostic procedures to determine the vitality of the tooth but it is regarded by many men as the least valuable diagnostic sign. This is usually performed by striking the tooth with an instrument. A dull sound indicates a pulpless tooth while a clear sound results from a vital tooth. Palpation is used to determine whether pressure on the crown produces pain in the apical region or if pressure on the mesial, distal, buccal or lingual surfaces produces pain. If pressure on the crown produces pain it is indicative of apical involvement, while pain from pressure applied to other surfaces indicates periodontal or pericemental involvement.

Heat and cold are often used to detect stages of pulpitis. Before the congestive stage of the pulp involvement, both will produce pain; however, when congestion does occur, cold relieves and heat produces pain.

The patient should be questioned as to a description of any pain elicited by any tooth or teeth in question and this together with one of the suggested pulp tests will usually suffice to make a diagnosis.

In our examination we should recall that hyperemia of the pulp consists of a sudden expansion of its blood vessels which usually is in response to a thermal shock. It may be due to caries of the dentine, chemical irritation, grinding on the tooth with a bur, placing of a metallic restoration close to the pulp or to trauma. Freedom from this type of pain is usually the death of the pulp, so this information is important in diagnosing a pulpless tooth.

Opening of the crown of the tooth in question may reveal a dead pulp and the passing of a broach into the canal and through the apical foramen may or may not produce pus. If there is no pus, then further examination must be made to determine whether a granuloma rather than an abscess is present.

As a matter of routine each tooth should be tested for vitality. Many canals have been left unfilled, while in others so little resorption of apical tissue has taken place about devitalized teeth that it is impossible to determine by a roentgenogram whether a tooth is vital or not.

According to Miller, an acute pulpitis shows an abnormally low threshold of irritability or irritation point; if suppuration is present the threshold will be high; if necrosis is present there is no response; abraded teeth with exposed dentine will have a low threshold; in case of a granuloma, the tooth is nonvital. Teeth in the immediate area of tumors and in osteitis fibrosa may be vital; the tooth causing a radicular cyst is nonvital. In the case of a

may often be seen on the tongue as white elevated patches of irregular outline which may be fissured. Swellings of the tongue may include lymphangioma, aneurysm, fibroma, lipoma, epithelioma and carcinoma.

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In the examination of the hard structure of the oral cavity the above stated is a good thought to keep in mind. We must observe the functional as well as the structural aspects in our examination.

If this examination is the first one made by the dentist, the dentition both present and absent should be fully recorded. Then upon subsequent examinations the record card should be adjusted to show the dentition as it exists at that time. The occlusion of the teeth is noted on the first examination regardless of age and its condition. This can be made by the use of Angle's classification of malocclusion. To further our data for making a functional diagnosis, it is necessary to have a structural recording by means of study models properly mounted on a good articulator. Here we can observe the factors of articulation, the condition and relation of the teeth to each other in the same and opposing arch.

The teeth should be examined in an orderly and systematic manner by the use of explorers, mouth mirror and a strong light. All visible carious lesions, abrasions, erosions, exposed cementum due to recession of the gingiva, open contacts, calculus and color should be carefully noted and recorded. Any departure from the normal in shape, position or arrangement should be noted, as this usually means diminished function.

A study of the proximal and occlusal contacts of the individual teeth should be made as this will most often reveal the cause of diseases of the investing tissues of the teeth

A tooth that presents discoloration is not always an indication that something is wrong with the pulp but it should be suspicious until proven otherwise. Testing of the pulp can be made by several means. This is a valuable aid in diagnostic procedures Probably the most satisfactory of these is the electrical pulp tester, however, this device is not infallible. It is based on the reaction observed when a weak electric current is passed through the tooth which reflects the sensory innervation of the tooth as compared to a sound vital tooth that is a complement to the tooth in question.

All crown and bridge work should be examined thoroughly and note made of occlusion, the location and type of bridge abutments for future references.

In all cases, examination of all glands and nodes in and around the oral cavity should be made. Normally these are not plainly palpable, but where any swelling is present they can be easily palpated. The enlarged lymph nodes along the submaxillary area and along the superficial lymph node area can be palpated with the finger. These swellings should be carefully examined. They may be the result of abscesses around the teeth or mouth, fractures of the jaws, tumors, cysts, stones in the ducts, diseases of the salivary glands or of the lymph nodes and syphilis. It should be noted whether the enlargement of the part is inflamed, hard, soft, painful, tender to touch, movable or fixed, whether it pits on pressure and the degree of involvement of other surrounding structures. If these conditions are present, any information regarding previous oral disturbances should be noted.

Blum says a knowledge of the condition of the lymph nodes and salivary glands is necessary in every instance. His suggestion for examining them is as follows: Stand in front of the patient and place the right hand on top of the head, which is slightly bent forward and held in position, while the fingertips of the left hand with the palm turned upward palpate the right glands through the loosened tissue of the neck internal to the lower border of the mandible by sort of rolling them under the fingers. Reverse this position for the left side. Palpation and massage of the salivary glands except sub-lingual, and compressing of the ducts toward their mouths will permit a study of the same and their secretions.

Discovery of an unyielding nodule along the course of a duct which exhibits tenderness and pain usually denotes the presence of a stone. If swelling is present and there is no induration of the surrounding area it may be regarded as a non-suppurative inflammation, while the suppurative type will present considerable localized edema and fever.

Probing of the ducts for calculus may be done to detect presence of such. Sialography may be of useful information in cases of obstruction of the ducts.

The operator should be well versed in the reading and interpretation of roentgenographic findings and capable of using this means as a diagnostic aid. Full mouth roentgenograms are advisable in all examinations of the oral cavity and valuable as a diagnostic aid when considered as one of the steps in a plan of differential diagnosis. All infected areas may not appear on the roentgenogram

follicular cyst the condition is derived from the tooth follicle, therefore the tooth may be vital.

A survey of the entire supporting structures of the teeth should be made and all pockets should be noted as to their location, depth and outline. The value of the teeth as units of mastication is largely determined by the strength of their attachment to the alveolar process and their freedom of disease. This should be noted in our examination, such as, the teeth present, their solidity in the alveolus and the degree of pathology of the soft tissue adjacent to them. Undue stress upon certain teeth due to malocclusion which may cause destruction of the supporting tissues is of great importance to look for in examining the occlusion so that these things can be corrected before too serious involvement has taken place.

Note should be made of the presence of a torus palatinus or torus lingualis. The latter is usually bilateral and should be observed. In cases of edentulous alveolar ridges and inspection of the flabbiness of the tissue over the ridge, any elevations present which would require surgery before prosthetic appliances are placed and the overall shape, size and form of the arches and relation to each other should be noted.

All teeth should be tested for mobility and degree of such recorded and classified.

Along with examination of the teeth care should be made in examining the margins of all previously placed restorations with an explorer in every position not visible to the operator. The teeth should be as dry as possible in this procedure, especially the gingival margins. Overhanging margins can be detected in this manner as well as by radiograph findings. Floss may also be used to detect this condition. Faulty contours, open contacts and improper anatomy should all be noted and recorded.

The use of disclosing solution is a valuable aid in detecting only the slightest presence of decay. Any chipping or fracture of metallic fillings should be observed. All restorations should be tested for mobility and any evidence of "leaking" should be recorded. All pulpotomies, root canal fillings, large cement bases, deep metallic fillings and any decay beneath previous restorations should be noted from roentgenographic findings and recorded.

The position, class and type of all metallic and porcelain or synthetic restorations present should be recorded on the diagnostic chart so that they can be quickly observed from it. For example, all previous restorations by other operators may be made in red and the present operator's be recorded in blue.

diseases, acute inflammations and fistulas are disclosed by it. Teeth which lack translucency are generally pulpless, and those whose roots cast a shadow through the overlying gum are usually affected with periapical disease. Decay and calculus may be detected by this means If teeth in close relation with the floor of the sinus are suspected, transillumination of this cavity is made through the mouth and orbit. Transillumination for the purpose of disclosing a pathologic condition in the periapical bone is reliable only where the condition extends to the periodontal or soft tissues.

There have been many misconceptions concerning the action and importance of the temporomandibular joint. The basis of incorrect diagnosis and treatment of irregularities of dental occlusion has been derived from this misconception. It was believed that this joint was a type of ball and socket joint and changes in dental articulation would only affect it slightly. This could readily be established by recalling the numerous cases of traumatic occlusion and malocclusion. The normal jaw and normal bite relation is a rarity; however, in initiating therapy it is based on the normal assumption

Many symptoms are associated with disorders of this joint such as stuffiness of the ear, buzzing tinnitus, crackling and snapping noises, pain in and about the ears, dizziness, alleged sinus symptoms, headache localized to vertex and occiput and side of neck, burning sensation of throat and tongue, difficulty in opening jaws especially on arising, and limited and painful opening.

In examining the patient all these things should be discussed with him in an attempt to diagnose the condition. Observation as to whether the patient has a full complement of teeth should be made and, if so, whether occlusal irregularities are present. Loss of teeth may cause elongation or migration of antagonizing and approximating teeth as well as changing the steepness of the occlusal inclines and should be noted and recorded in the examination. Abnormal tooth wear due to "night grinding" or improper grinding of the occlusion may produce these symptoms. Faulty and improperly contoured restorations which restrict normal function may account for the disorder. Examination of any partial or complete dentures which have not been corrected for ridge resorption should be made in an effort to diagnose these cases.

It is believed the joint movements do not change during life unless the patient has some destructive disease of this area or experiences some injury to the joint. They remain the same throughout changes of the dentition and do not alter after the teeth have been removed. They do not change due to misfit of artificial teeth unless

as they only show well the changes in density of the hard tissues, thus a negative result does not prove the absence of a pathologic condition.

In oral diagnosis the roentgenogram must be used as an adjunct to other clinical findings, not alone. Even though it may show more valuable information than any other factor, it is of little value alone. For example, an infected tooth may appear to be normal. A radiolucent area may be due to traumatic occlusion rather than infection. Radiolucent areas of the bone may be shown but with no evidence of pus, infection or repair.

Along with the standard full mouth periapical examination, bite wings, extraoral and occlusal films are essential for complete oral examination and diagnosis.

From these films we can determine the conditions of previous dental restorations as to shy or overhanging margins, decay of the proximal surfaces as well as decay under previous restorations. We can determine the condition of the supporting structures of the teeth as to presence of resorption of bone, the presence extent and depth of periodontal pockets, the condition of the periodontal membrane and extent of the maxillary sinus. We can see the presence of impacted, embedded and supernumerary teeth, cysts, granulomas and other pathological lesions as diagnosed by the aid of other clinical findings.

The result of former root canal therapy can be observed and evaluated as to whether the canal was completely filled or not Any evidence of calculus formation in the salivary ducts as well as on the teeth may be revealed.

Anatomical landmarks can be viewed and are valuable in the location of various conditions. All periapical lesions such as chronic rarefying osteitis with granulomatous tissue or suppuration and its extent can be seen. Periodontal abscesses, thickening of the periodontal membrane, loss of interalveolar septum of bone, osteomyelitis, alveolar resorption, root resorption, pulp stones, sialolithiasis, hypercementosis, sinus involvement, all forms of cysts, root tips, osteitis fibrosa, adamantinomas, odontomas, exostosis, endostosis, many forms of tumors and deformities can be viewed and diagnosed by the aid of the roentgenogram. The condition of the pulp as to size and extent can be observed. Many times carious exposures can be determined by this means.

Transillumination as an aid in examining procedures is indispensable, and in many cases may be the only positive means of diagnosing the presence of infection While not all infected areas are shown by transillumination, many conditions such as periodontal

acter and spread readily through the fascial planes toward centers of lymph channel drainage as in cellulitis.

Of further value in diagnosis is a history of the swelling. For instance, acute dento-alveolar abscesses have a history which is usually unmistakable in character. Also in the history inquiry should be made concerning the previous treatment.

Trauma and Pathology. It is sad but an actuality that many of the inflammations of the mouth are due to, rather than to be corrected by, oral surgery. One of these is postoperative edema and inflammation due to trauma and invasion of the tissues by bacteria through open incisions. Bacteria may be introduced into the tissues by the hypodermic needle during administration of an anesthetic solution. These cases are, as a rule, not serious, but are disagreeable to the patient and time consuming for the operator to treat.

Care should be taken to prevent excessive trauma to the tissues by carefully using an accepted technique, and the possibility of bacterial invasion lessened by sterile precautionary measures as much as possible. Tight suturing should be avoided, for this is often the cause of great amounts of swelling of the edematous type. Only enough sutures to properly approximate tissues should be used and these placed with care.

Another possible postoperative cause for swelling is the rupture of blood vessels resulting in a hematoma. This condition should and could be avoided in most instances. Hematomas are unsightly and cause considerable pain before they resolve. If possible the ruptured vessel should be tied off and the blood aspirated before suturing is done.

Occasionally a crackling sound is heard in the swollen tissue identifying emphysema. Emphysema may occur following extraction if any type of harsh or vigorous blowing (nose, pipe stem, musical instrument, etc.) is done. Air is forced between the muscles and fascial planes of the tissues and can be quite far-reaching.

One of the swellings most frequently seen occurring in the mouth and jaw region due to dental causes is the acute dento-alveolar abscess. The cardinal signs of inflammation are evident and a carious tooth or teeth may be seen clinically as the offender. In some instances, however, caries may not be present. The offending tooth may have been devitalized by a traumatic blow.

Roentgenographically there may be either apical or lateral rarefaction seen, the amount determined largely by the age of the abscess and the volume of suppuration. In early stages there may be no rarefaction detected. There is a history of severe pain with a gradual recession to a chronic aching and extreme tenderness

the resistance of the misfitting teeth is sufficient to cause temporary or permanent disease to the joint. Because we must adapt our restorations in harmony with these joint movements, they are important to oral examinations and diagnosis.

All of the aforementioned subjects, if carefully considered and recorded, will in our opinion constitute a good and complete oral examination. As the dentist learns to incorporate all of these facts in his examination, he will too, with experience and a good case history, be able to conduct a rapid examination of the oral cavity which will greatly enhance the further treatment planning for the individual patient.

Utilization of the above mentioned suggestions will increase tremendously the powers of observation and conscientiousness of the practicing dentist and physician, then he will become more proficient, perform a much better service for his patients, and at the same time elevate the profession in the eyes of our numerous observers.

SWELLINGS PERTINENT TO THE ORAL CAVITY

Swelling may be defined as a morbid enlargement of an area of tissue. For the convenience of the reader this portion of the chapter will be divided into two parts: those swellings arising due to trauma and pathology and those from neoplastic growths. Swelling may be the result of trauma to the tissues followed by response to injury, or pathology. that is, the tissue response following injury of tissues by bacteria. viruses, or their toxins, or neoplastic growths.

One of the chief methods, the first used to say the least, of diagnosis of swellings of the face and jaws is a close observance of fascial topography or physiognomy. A swelling of the face may be localized as to maxillary or mandibular position. The corners of the mouth seem to form a sort of boundary line between these two. It has been noticed by close observance that generally a maxillary swelling will, upon progression, tend to follow the fascial planes upward to the scalp, whereas a mandibular swelling will spread downward into the neck. Also it should be noted whether the swelling is bilateral or unilateral. Is the swelling edema (pits upon pressure), or inflammatory (firm, red, and having a higher than body temperature), in character? If the swelling is of an inflammatory nature, its extent should be observed. An acute abscess has a tendency to localize and, when treated with hot applications or mouth soaks, to become fluctuant intraorally or to the external surface. On the other hand, inflammation may take on a diffuse char-

acter and spread readily through the fascial planes toward centers of lymph channel drainage as in cellulitis.

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due to the exudative pressure on the bone being somewhat relieved by extravasation into the soft tissues. The swelling increases during this period, spreading in all directions through the fascial planes upward to the eye and downward to the neck.

The treatment of acute dento-alveolar abscesses varies according to the doctor. Some will extract the offending tooth to provide drainage. Others advocate the incision and drainage of the abscess when it becomes fluctuant and the extraction of the tooth at a later date when the infection has been reduced to a sub-acute or chronic stage. Incision and attempted drainage before the area becomes fluctuant will result in a prolonged edema and healing period.

An allergic reaction presenting an appearance to the layman very similar to that of the acute alveolar abscess is angioneurotic edema. These reactions are usually due to some food allergy and, even when the patient has suffered attacks before (undiagnosed), the dentist is approached and asked to remove the tooth which is abscessed. Accurate diagnosis is necessary in such cases.

The signs and symptoms of angioneurotic edema include a rapid onset, massive swelling of the lips, tongue, cheeks, and periorbital tissues. Sometimes the hands, feet, and genitalia are involved There is, as a rule, no discoloration of the swollen area, no intense pain other than the burning, itching, and general discomfort due to the distended skin. Swelling is of a similar consistency to the adjacent tissue. Other diagnostic aids are history, lack of previous infection, sudden appearance, and its still more sudden resolution.

Another disease thought by some to be confusing is the disease affecting the parotid gland known as mumps. This is a virus infection causing swelling and pain in the parotid area. The swelling of the gland or glands is rapid. There is either complete cessation or excessive output of saliva. Extreme pain is the result of pressure Sour or bitter tastes also cause light pain.

Osteomyelitis is an inflammatory suppurative process of the bone As a low-grade inflammatory process, it is comparable to a chronic inflammation in soft tissue. The disease may be due to a local or distant infection. In the case of local infection such as an infected tooth, the inflammation has an exudate which, instead of remaining in one area as in an abscess, diffuses through the bone and, since the bone cannot expand as soft tissue does, pressure necrosis occurs. This necrosis is the typical picture of osteomyelitis with a rarefied area presented roentgenographically.

Actinomycosis is a chronic, suppurative disease resulting from an infection with the fungus Actinomyces hominis There are some

eighty forms of Actinomyces, all presenting a similar pathogenic form when acting as an etiological agent.

This disease is characterized by great tissue destruction, pus formation, leukocytic infiltration, and production of a dense fibrous growth similar to a fibrous tumor. The etiology or causative factor in the invasion of the tissues by Actinomyces is unknown.

Diagnosis is by isolation of the fungus from the pus of the lesion. There is no specific therapy for actinomycosis and radical surgery is most often adequate. Surgical drainage, however, is necessary.

Another cause of swelling is the cyst. There are cysts found in the mouth due to many etiologies. Those on the surface of the mucosa which are usually formed from the mucous glands found there, are known as mucoceles, and are easily recognized by their proximity to the surface and the vesicle-like appearance. These are easily removed by excising the tissue and removing both cyst and gland. Removal of the gland and lining prevents the recurrence of the cyst.

Another common type of swelling is the radicular cyst. It is usually diagnosed radiographically as an area of rarefaction around the apex of a tooth or teeth. There are usually no subjective or objective symptoms until the cyst becomes quite large at which stage it may cause considerable pain.

The radicular cyst is easily recognized by radiographs, in that it presents a well defined, distinct white line of cortical bone around its epithelial lined periphery. The treatment involves surgical enucleation. Exceptionally small radicular cysts are removed routinely during apicoectomy by curettage.

Other types are the follicular or dentigerous cysts arising from the tooth follicle, multilocular cysts or adamantinomas, median maxillary fissural and naso-palatine cysts.

Swellings are seen in the mouth due to the tertiary luetic lesion gumma. These present themselves as painless swellings at first, involving the submucosa or periosteum. Later they spread laterally along the submucosa to cause a larger area of swelling and form somewhat more slowly, encroaching upon the bone to form a radiolucent area. There is a close resemblance between gummas and carcinoma in clinical and radiographic appearance. Positive diagnosis is made by biopsy and serological tests. The treatment for this condition is antisyphilitic, such as antibiotics and arsenicals. Local treatment of the infection and removal of necrotic bone and devital teeth are occasionally necessary.

Larger, more diffuse swellings of the face and neck may often be seen. These are frequently the outcome of odontogenic injections,

osteomyelitis, and septic fractures of the jaws. Some are classified as cellulitis, septic lymphadenitis, phlegmons, and venous thrombosis. All of these mentioned may have serious consequences and may be divided into three periods. The first period is seen as that during which the initial lesion develops, the second being the period of extension to the fascial spaces, and the third period being that of serious complications through embolism, pyemia, or septicemia. Other possible complications may be brain abscesses, meningitis, choroiditis, or transverse myelitis.

Acute cellulitis is produced by an extension of an infection into the alveolar tissue filling the fascial spaces and the loose subcutaneous tissue. Edema and redness are seen in the area and often greater spread is rapid. The swollen part is tender to touch and the skin covering it has a brawny, indurated character. Physiological changes include a temperature of 100°-105° F., a feeble, rapid, and irregular pulse, and an increased rate of respiration.

Lymphadenitis is another infection of the face and neck. This may be the result of a dental infection which progresses to the lymph nodes and adjacent tissues, producing suppuration there. The appearance of this disease is similar to a direct infection of the region.

The therapy for these diseases is divided into three phases. The first is antibacterial treatment to reduce the number and virulence of the infectious organisms. This is accomplished principally by the use of antibiotics. Secondly, the source of infection is removed, and lastly drainage or aspiration of the pus is effected. It must be kept in mind however, that before any operative procedures are instituted, the infection should at least be brought under control, if not completely cleared. Removal of the abscessed tooth, root tip, or whatever is the source of infection is the operator's job along with incision and drainage or aspiration of the pus from the tissue.

A striking complication following oral surgery is the submandibular phlegmon known as Ludwig's angina. This condition actually is not a particular disease or condition, but is a complicated combination of infections. It is an exceedingly serious complication to any infection.

In Ludwig's angina, one or both submaxillary spaces may be involved. There is a large amount of pus formed with most of it concentrated near the inner surface of the mandible, although occasionally the body of the tongue may contain most of the pus.

The floor of the mouth appears hard and brawny. The tongue is elevated and inflamed, while the skin over the submaxillary region becomes indurated and dusky red in color. The massive swelling

present may soon spread downward to the sternum, laterally to the sides of the neck, but no further upward than the corners of the mouth. Trismus and dysphagia usually manifest themselves and occasionally dyspnea is evident due to swelling in the neck.

The therapy for Ludwig's angina must be immediate and heroic. Massive dosages of antibiotics should be administered and deep incisions with blunt dissection made for drainage. If respiratory embarrassment is still not relieved, the operator may resort to the procedure of a tracheotomy.

NEOPLASTIC GROWTHS. Any swelling suspected of being neoplastic in nature should be biopsied. If found to be malignant, a more radical approach of surgical removal should be instituted than if the growth is found to be benign. This is the greatest disadvantage to surgical treatment of cancers, that is, the necessity of a radical or, as some surgeons prefer, an "adequate" procedure to preclude the possibility of recurrence.

The epidermoid carcinoma is the most common type of cancer seen in the mouth, making up about 90% of the cancerous growths seen on the mucous membrane.

At the start of this malignant lesion, a wart-like growth having a hornified covering is seen. As the growth progresses the surrounding skin becomes nodular and raised and the size of the involved area increases. Still later the wart-like growth may develop into a large, wildly growing, fungating type in appearance. Other types of oral cancer which are frequently seen are adenosarcomas, adamantinomas, and transitional cell carcinomas.

Benign neoplasms are not as dangerous as malignant ones in that they do not invade and destroy surrounding bone and soft tissue, nor do they metastasize. However, one should maintain the thought as a rule that all neoplasms must be considered as malignant until proven otherwise.

Some of the benign tumors seen in the mouth and jaws are: fibromas, inflammatory hyperplasia, lipomas, osteomas, chondromas, and odontomas. The diagnosis of these tumors is by clinical signs and symptoms and biopsy.

The hemangioma is a benign tumor of particular interest. It may occur in the soft tissue of the lips and may be easily diagnosed by its bluish color and disappearance upon pressure. Occasionally hemangiomas have been found around apices of teeth appearing radiographically as a radiolucent area. Extraction of such teeth can lead to profuse, uncontrollable bleeding with possible expiration of the patient. Hemangiomas are tumors made up of blood vessels and seem to have an unlimited blood supply.

A fitting concluding statement is that it may be readily seen that a diagnosis of any condition is often made more simple by the elimination of or the differentiation from other conditions having a similar clinical appearance. Differential diagnosis is sometimes the principal factor in diagnosis of a disease or lesion.

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4

Types of Oral Cancer

THE fact that cancer, in general, occupies second place in the death rate of the United States needs strong emphasis. Fear, delay, and ignorance, as always, continue to be the allies of disease and the enemies of cure. Cancer is a deadly creeping, self-assured disease. It is not contagious, nor is it caused by a microorganism. The United States Report on Vital Statistics for 1939 indicated that over 5,012 deaths were due to intraoral cancer. In accordance with these facts, the dental surgeon plays an important role in the early detection of cancer and thus in its prevention.

The word "cancer" is used to include all the various types of malignant growths occurring in any part of the body, resulting from certain changes that the body cells undergo.

This chapter is dedicated and limited to the neoplastic growths that may be encountered through oral examination. Therefore, we may immediately arrive at the conclusion that a complete and thorough examination of the mouth is necessary upon any patient's presentation.

Oral cancer is a broad, nonspecific term which may be more clearly defined. Instead of using the term oral cancer, perhaps the term oral neoplasm is in order because of its all-inclusive and scientific character. A tumor or neoplasm may be defined as a disorderly growth of new cells which proliferate without control and which serve no useful function, an abnormal new growth of tissue. It is an autonomous, progressive, unlimited new growth of cells, without known cause or useful function, which always produces some harmful effect or death of the host. A neoplasm, which in its growth has the capacity to directly invade and destroy surrounding tissue, to set up secondary growths of a similar character, and to recur after incomplete removal, is called a malignant neoplasm. Other neoplasms which do not exhibit these characteristics are termed benign neoplasms. Cancer is a semi-scientific or lay term which carries the connotation of malignant neoplasm. Thus, when we say oral cancer, we indicate all forms of malignant neoplasms of the oral cavity. The word tumor, which literally means swelling, is a lay term for benign neoplasm. These changed cells multiply and

destroy neighboring healthy cells and keep growing. Some grow rapidly, and some slowly, some spread (metastasize) quickly through the body, while others do not.

Tumors of the oral cavity have been classified in various ways. Mallory has classified tumors according to the histological peculiarities. This classification is generally accepted by pathologists. Albright's classification is based on the location of the tumor.

For our purpose, it seems that the simplest method is to classify tumors of the oral cavity into the connective tissue and the epithelial tissue types. Ginn's classification as to types of cancer is as follows:

I. Epithelial Tumors
  A. Benign
    (1). Papilloma
    (2). Adenoma
    (3). Ameloblastoma
  B. Malignant
    (1). Squamous-cell carcinoma
    (2). Basal-cell carcinoma
    (3). Adenocarcinoma
      (*a*). Mucoid carcinoma
      (*b*). Scirrhous carcinoma
      (*c*). Carcinoma simplex
II. Connective Tissue Tumors
  A. Benign
    (1). Fibroma
    (2). Lipoma
    (3). Neurofibroma
    (4). Myxoma
    (5). Chondroma
    (6). Osteoma
    (7). Myoma
    (8). Lymphoma
    (9). Angioma
      (*a*). Hemangioma
      (*b*). Lymphangioma
  B. Malignant
    (1). Fibrosarcoma
    (2). Lipoma
    (3). Neurogenic sarcoma
    (4). Myxosarcoma
    (5). Chondrosarcoma
    (6). Osteogenic sarcoma
    (7). Myosarcoma
    (8). Lymphosarcoma
    (9). Angiosarcoma
    (10). Undifferentiated sarcoma
      (*a*). Spindle-cell sarcoma
      (*b*) Small round-cell sarcoma
      (*c*). Large round-cell sarcoma
    (11). Mesothelioma
III. Mixed Tumors
  A. Benign form
  B. Malignant form

IV. Teratomas
   A. Benign form
   B Malignant form

It must be kept in mind, however, that there is no definite universally accepted classification for the many types of cancer.

Before entering into a discussion of the types of neoplasms, a clear understanding of the various terms should be undertaken. Better understanding of benign and malignant forms can be seen from the following:

I. Benign
   1 Grow slowly
   2 Expansive growth
   3 Usually encapsulated
   4 Do not recur after careful removal
   5 Do not metastasize
   6. Do not kill unless they compress vital organs
   7 Rarely show necrosis and ulceration
   8 No cachexia
   9 Consist of well-differentiated cells
   10 Cells are rather uniform in size and shape
   11 Nuclei take up stain normally
   12 Few mitoses
   13 Fairly good imitation of the arrangement of the tissue from which they are derived
   14. Cells do not infiltrate

II. Malignant
   1. Grow rapidly
   2. Invasive growth
   3 Not encapsulated
   4 Recur after incomplete removal
   5. Do metastasize
   6 Do kill
   7 Often necrosis and ulceration
   8 Cachexia and anemia
   9. Consist of poorly differentiated, anaplastic cells
   10 Polymorphism of cells
   11. Hyperchromatic nuclei
   12. Numerous multipolar mitoses
   13. Unsuccessful imitation of the tissue of origin
   14. Cells do infiltrate

Malignant neoplasms may be differentiated histologically into two major categories· the sarcoma, which arises from connective tissue, and the carcinoma, which arises from epithelial tissue. These two types are frequently confused by one who does not often come in contact with cancer cases. It must always be borne in mind that sarcoma is the mesoblastic or connective tissue type, and that carcinoma is the hypoblastic or epithelial tissue type.

Frequent hemorrhage in the case of sarcoma is due to the blood vessels without muscular walls or the blood running freely between the cells. Carcinoma, on the other hand, has true blood vessels

present in the epithelial tissue framework. The growth of a sarcoma is not always continuous but is subject to interruption, whereas growth of carcinoma is rapid and continuous. The sarcoma, being of connective tissue origin, usually begins in deep structures and therefore grows primarily outward; while the carcinoma, being of epithelial origin, usually begins superficially and grows inwardly. A sarcoma is more or less subject to secondary changes which are chondroid, osseous, and calcific in nature. Frequent pigmentary changes have been noted. Carcinoma, on the other hand, rarely demonstrates secondary changes. Grossly, the sarcoma is flesh-like, rounded and regular, while on section it presents a smooth, pearly, red tinge. Grossly, the carcinoma is nodular, irregular, and is usually ulcerated on the surface, and on sectioning it is granular, opaque and less red than the sarcoma. As a general rule the sarcomas grow more rapidly than do the carcinomas.

A papilloma is an innocent or benign tumor and may be squamous or mucous depending on whether it grows from a squamous or a mucous surface. A papilloma, however, may become malignant A squamous papilloma is most common in the skin but may occur in the mouth, larynx, or any other cavity lined by stratified epithelium. A mucous papilloma is one that grows from any mucous membrane.

An adenoma is an innocent epithelial tumor of glandular structure. Adenoma is a distinct tumor which only rarely forms from the oral mucosa. The pure adenoma, which is a very benign tumor, should be differentiated from the adenoid type of mixed tumor which is more commonly encountered. The malignant form, adenocarcinoma, will be described in the following paragraphs.

The adenoma forms from glandular structures and therefore may occur on the palate, cheeks, lips, and the floor of the mouth. Embryonic epithelial rests, however, may develop into adenoma just as they may develop into adamantinoma, having both odontogenic and glandular potentialities.

The adenoma is probably more often seen on the hard and soft palates than on any other part of the mouth. Eggers (1928) described two adenomas occurring on the hard palate and pointed out that they should be differentiated from mixed tumors occurring commonly in this area.

Ringertz (1938) also described 2 patients, one a woman, aged thirty-two years, the other a man, aged fifty-nine years, with adenomas on the anterolateral part of the hard palate. They were of hazelnut size and somewhat lobulated in appearance with normal mucosa

Adenomas are generally well encapsulated and are not of infiltrating character, although they may cause resorption of the underlying bone by pressure. Occasionally, however, they may be locally malignant, as in the case reported by Colyer and Spawson (1931).

> "The adenoma occurred on the hard palate of a woman, thirty-seven years old, and was accompanied by lancinating pain. Several teeth had been extracted because they had been considered the cause of the swelling. Three years subsequently the tumor was excised, and and on examination the removed tissue was diagnosed as a malignant and infiltrating adenoma."

The adenoma is usually encapsulated. Different types occur and are spoken of as tubular, alveolar, and alveolocystic adenomas. In the tubular type, the epithelium forms cords of cuboidal or cylindric cells, which have the appearance of excretory ducts with superimposed central masses of cells of more polygonal or spherical character with abundant cytoplasm. In the second type alveolar formations dominate the picture. Cells are of cuboidal or cylindrical shape, large and light, and may or may not secrete mucus. In the alveolocystic adenoma mucus may distend the acini and form cysts. Evidence of encapsulation indicates that the tumor is probably not of an infiltrating character and will not recur, and the presence of a basement membrane between the tumor cells and stroma is a further sign that the tumor is benign.

The carcinoma may be divided into three main histologic varieties: adult hornifying squamous cell, transitional cell, and basal cell. There are several sub-varieties of each of these, which are distinguished by structural, etiologic, or clinical features. Of these three main types, the squamous cell variety is the most common in the oral cavity region. These squamous cell tumors occur either as papillary or as ulcerative infiltrative lesions. The papillary type occurs as a wart-like thickening which long remains elevated and at times with much elongated papillae. It extends slowly in all directions as a flat area of thickening in the epidermis. It is slow to invade the deeper tissues or lymph nodes, and the underlying tissues remain soft. Later, this type of growth may ulcerate and follow the usual course of the infiltrating carcinoma. The papillary type is usually of long standing and somewhat characteristic gross appearance. Since it usually responds to conservative treatment, it can be differentiated from the more virulent infiltrative type.

Ulcerative infiltrative carcinoma may appear as a flat area of thickening of the epithelium, or as a massive growth, from the first invasion of the submucosa. It lies beneath rather than in the

epithelial layer. Early ulceration produces a broad deep ulcer with a pearly indurated edge, or a more bulky excavating growth which may become fungating. Associated with these lesions, there is commonly much inflammatory reaction, extension along the floor of the mouth, involvement of the mandible, and early invasion of the nearby lymph nodes. The squamous cell carcinoma may originate on the mucosa in any area of the oral cavity, but it does not originate in the bone.

Transitional cell carcinoma occurs in the oral cavity on the base of the tongue and on the mucosa of the vault. The mucosa in these areas contains stratified epithelium. These tumors are not as a rule bulky. Their tendency is to be small and to infiltrate, and they are easily overlooked, but they early invade the lymph nodes draining the affected area. The first sign of the disease is generally an enlargement of the cervical nodes. Infiltration of tissue spaces, lymphatics, and blood vessels is the criterion of fully developed carcinoma.

Basal cell carcinoma does not primarily occur within the oral cavity and does not often metastasize. These growths, however, may involve the oral cavity region by extension. Histologically, they occur as reticulated and as adenoid carcinomas.

Squamous cell carcinoma, also called an epithelioma and an epidermoid carcinoma, is found in the skin and wherever there is squamous or transitional epithelium. Therefore, it may involve parts of the body such as the lip, mouth, tongue, larynx, cervix, uterus, bladder, esophagus, bronchial mucosa, or gall bladder.

Squamous cell carcinoma is found quite often on the lower lip. The etiology appears to be chronic irritation. This irritation is thought to be caused from factors such as excessive exposure to sunlight, pipe smoking, bad oral hygiene, carious and sharp defective teeth, infected teeth, trauma, artificial bridges, fillings, dentures, irritation from food in open contact points, and by drugs. It is also thought that leukoplakia may be the precursor of carcinoma.

The clinical aspect of the squamous cell carcinoma shows that there are many varieties of these tumors, and also that secondary infection and trauma can further complicate the clinical picture. For instance, two main types of carcinoma of the lip, the papillary type and the ulcerating or infiltrating type, were distinguished by Ewing. Between these two types there are even more transitional forms. However, accurate classification beyond that of the two main types is often considered academic.

It is interesting to note that epidermoid carcinoma occurs more often on the lower lip and on the tongue of men than women.

Epidermoid carcinoma of the tongue is known to be one of the most malignant types of cancer.

The intra-oral tumor of this type is a comparatively slow-growing tumor which more often invades adjacent structures than it metastasizes to distant parts. The prognosis appears to be favorable if the tumor is removed while still measuring under 1 centimeter in diameter; that is, at least 60 per cent of the cases can be cured.

The incidence of carcinoma of the lower lip is about 20 times greater than that of the upper lip. It occurs usually after fifty years of age, but may occur at an earlier age. About 85 per cent of all intra-oral cancers occur in males.

Carcinoma of squamous cell type is the most frequent form of oral cancer and because of varying incidence, specific methods of treatment, and specific factors of etiology in various anatomical locations, it is expedient to discuss each area individually.

Carcinoma of the lip is the most common site of oral cancer. It comprises 48 per cent of all oral cancers or 7 per cent of all cancers in the male. We have to state the sex, because oral cancer is very common in the male, but less so in the female. Ninety-three per cent of carcinoma of the lip occurs in the male.

Carcinoma of the lip is most often hornifying squamous cell in type, although basal cell and mediocellular carcinoma occasionally occur in this location. The squamous cell carcinoma of the lip usually arises on the vermilion border in a lateral position and is frequently preceded by an area of leukoplakia. Leukoplakia is the result of long continued irritation such as might be produced by sharp irregular teeth which impinge on the lip, biting habits, smoking or climatic exposure. The higher incidence in the lower lip is due to its position which is conducive to more frequent trauma and greater exposure.

The lesion begins as a slightly elevated plaque which is white in color and rough or slightly warty in appearance. Gradually it becomes thicker and more verrucous in appearance. The borders are thickened and rolled and acquire a pearly character; the base of the area is indurated and there is evidence of infiltrative growth The lesion shows a tendency to erode or ulcerate. The area becomes painful and tends to bleed easily on manipulation. In many cases, the carcinoma is not preceded by an area of leukoplakia, but starts as an area of erosion or ulceration As the ulcer increases in size, there is a thickening and rolling of the border, with induration and infiltrative growth at the base. These early eroded lesions are frequently confused with herpetic lesions and occasionally, chancres However, herpetic lesions usually heal within two or three weeks.

Carcinoma of the lip metastasizes by the lymphatics to the regional lymph nodes. It may be treated by surgery, *x*-ray irradiation or radium implantation.

In all except the very early cases, a careful and extensive suprahyoid lymph node dissection should be a part of the initial treatment, to eliminate the early metastases which occur and thus prevent more extensive spread of the neoplasm. If the dissection is delayed until there is clinical evidence of metastases, it is usually of such an extensive nature that complete removal is impossible. It is thought that surgical removal of the primary lesion with careful lymph node dissection offers the most favorable prognosis.

Carcinoma of the tongue is the second most frequent form of oral cancer. It comprises 1.9 per cent of all carcinoma and 15 per cent of all oral cancer in males, while in the female it comprises 0.3 per cent of all cancer and 13.4 per cent of all oral cancer.

Carcinoma of the tongue is almost always associated with chronic irritation. It occurs in the lateral surface which is frequently traumatized by sharp, broken down teeth, poor restorations, and poorly adapted clasps. The part played by chronic inflammation is exemplified in carcinoma of the dorsum of the tongue, which in over 51 per cent of the cases is preceded by a gummatous glossitis. As in carcinoma of the lip, the tongue lesions are frequently preceded by leukoplakia. The lesion in the tongue is the same as described for the lip. The rolled thickened, pearly border, surrounding an ulcer which has an indurated base, with evidence of infiltration into the surrounding area is characteristic. Metastasis is to the regional lymph nodes and takes place very early, probably because of the exceptionally motile character of the tongue.

Carcinoma of the tongue has a poor prognosis even when diagnosed early. Early metastasis and the difficulty encountered in complete removal of the primary lesion are responsible for the poor prognosis.

Carcinoma of the palate, buccal mucosa and floor of the mouth are frequently associated with chronic irritation produced by sharp teeth, poor restorations, and poorly adapted clasps, as well as the chronic irritation produced from chewing and smoking tobacco. Leukoplakia frequently precedes the development of the carcinoma. The incidence of carcinoma in these areas is lower than on the lip and tongue and the prognosis is poor because of the difficulty encountered in treatment.

Carcinoma of the alveolar ridge has, in most cases, a specific cause and, therefore, should be considered separately. One of the most common causes of carcinoma of the alveolar ridge is

loose, ill-fitting dentures. Continued movement of the dentures results in chronic irritation with marked hyperplasia and hypertrophy of the gingival tissue, which predisposes and irritates the carcinoma. Because of the relationship between carcinoma of the alveolar ridge and poorly fitting dentures, this condition is to a great extent the responsibility of the dentist.

Squamous cell carcinoma occurs more often after the age of forty-five, the large percentage occurring in men, and about 94 per cent being on the lower lip.

The squamous cell carcinoma which occurs in the floor of the mouth is also primarily a cancer of the male, usually over sixty years of age. It has been reported that in 103 consecutive cases, 98 per cent were males averaging sixty-one years of age. The etiology of this cancer is more obscure than for any other type since the area is protected by the tongue and there is a constant stream of saliva in the region to keep it clean. Since the symptoms of this cancer are very mild, it is usually very far advanced before it is discovered and diagnosed. The patient usually arrives complaining of a sore mouth. The early lesion consists of an indurated nodule about one-half centimeter in diameter, lying superficially in the mucous membrane with a grayish patch in the center. This tumor may ulcerate and grow laterally or tend to penetrate deeply into the membrane to deeper structures. The course of the lesion is rather rapid. It usually arises in the anterior portion of the floor of the mouth near the orifice of the submaxillary duct and spreads by direct extension. As the tumor grows and spreads to the submaxillary and cervical lymph nodes, the tongue becomes fixed to the mandible causing difficult swallowing and drooling. After this stage there is a rapid downhill course.

The transitional cell carcinoma, a highly malignant tumor, occurs most commonly in the nasopharynx and the pharynx and at the base of the tongue, as does also lymphosarcoma, with which it may be confused. Both are frequently extremely radiosensitive and, even in the presence of cervical metastasis, have disappeared completely under roentgen therapy. The pathology of these tumors has been studied extensively. It is the belief of Schmincke that they are epithelial neoplasms of branchiogenic origin, but many pathologists do not agree with this concept of etiology. They are composed of a net-like syncytium of epithelial cells with lymphocytes occupying the interstices, growing in true symbiosis. Ewing writes:

> "The transitional cell carcinomata arise from stratified epithelium of which the cells are delicate, without spines, do not produce keratin

> and show little capacity to hornify. . . . The structure of the growth shows sheets of large delicate cells with thin membranes, large nuclei, and indefinite cell outline. They infiltrate the submucosa in sheets or small groups or singly."

New, Broders, and Childrey state:

> "It seems superfluous to call such growths transitional cell tumors. To do so is to create another type of carcinoma when there is no sound basis for doing so. It seems better that their identity with squamous cell tumors should be maintained."

In clinical features, these tumors are different from the ordinary squamous cell carcinoma. The growth usually starts as a soft swelling without ulceration and may be mistaken for an abscess. The correct diagnosis and treatment may therefore be delayed, with disastrous results. Consequently, in such highly malignant tumors of the upper jaw and palate, the retention of the term "transitional cell carcinoma" might well be desirable in order that roentgen therapy may be promptly instituted rather than mutilating surgical excision be undertaken later, with almost certain recurrence. A case reported, now without recurrence for nearly twelve years and without deformity, might have ended disastrously had surgical measures been employed.

Basal cell carcinoma does not occur primarily within the oral cavity and rarely does it metastasize. These growths, however, may involve the oral cavity region by extension. Histologically, they occur as reticulated and as adenoid carcinomas. These tumors of the basal cells of the epidermis have the characteristic basal cell appearance. The basal cell carcinoma rarely metastasizes but erodes contiguous tissue and so has earned the name "Rodent Ulcer".

The adenocarcinoma rarely occurs in the oral cavity but there have been cases reported. Most of these were found in the hard or soft palate; however, there were some reports of the occurrence in the base of the tongue, buccal mucosa, and even on the alveolar ridge. Usually this neoplasm is a lobulated growth having a very firm consistency throughout although there have been cases in which it has appeared as a papillary growth which invades the underlying tissue. This neoplasm usually arises from some gland in the oral cavity and may remain unnoticed until it breaks through the mucosa and begins to ulcerate. It is usually firmly attached to the underlying bone which frequently becomes involved. This tumor may take almost any form; however, the surface is usually smooth and lobulated. The mucous membrane covering the tumor is usually not inflamed but is smooth and adherent to the mass.

This tumor metastasizes quite readily and re-occurs frequently after surgical removal.

Adenocarcinoma is not common within the oral cavity. It does not respond as well to irradiation as does the squamous cell carcinoma. It occasionally metastasizes, and it may be locally invasive. Humphrey and Amos (1936) reported a case of primary adenocarcinoma of the colon metastasizing to the gingival tissue, the lungs, and the liver.

The fibroma is a typically benign tumor and of frequent occurrence in the mouth. This tumor generally arises from the deep layers of the mucosa or from the periosteum of the jaws, and may arise from the periodontal membrane. The terminal stage of an inflammatory hyperplasia resembles it, as pointed out before.

The fibroma is a well-defined tumor. It may be sessile or pedunculated and may have a soft or firm consistency. Soft and hard fibromas are therefore distinguished. The former are of reddish color, the latter are covered by a pale appearing, smooth epithelium. The tumor grows very slowly and generally has a duration of many years. In some cases, it remains as small as a pea, but in others, it develops to a very large size.

Fibromatosis is another clinical variety of fibroma involving the entire gingiva in a diffuse manner. It is spoken of as diffuse fibroma or fibromatosis. The gingiva is not inflamed as in hypertrophied gingivitis, but it shows a normal smooth or nodular appearance of pale color as seen in hard fibromas.

Lipomas are formed in locations where adipose tissue is found in the oral mucosa. They are slow growing and benign. Malignant types are unknown. This tumor forms from fat cells contained in the areolar gingiva, or adipose tissue in the tongue, floor of the mouth, pharynx, and parotid glands. It expands gradually and is not resorbed in the manner in which natural fat stores are removed when losing weight. It is usually attached to the mucosa and produces pedunculated spherical or multiple formations with grape-like lobes. Being soft it moves freely and with the motions of the jaw or tongue. Sometimes lipomas are found in bilateral distribution on both sides of the tongue or pharynx.

The fat tissue exerts pressure on the epithelial surface, flattening out the papillae so that the yellow contents of the tumor shine through the thinned-out covering, and the subepithelial red blood vessels are clearly visible, which gives the tumor a unique and peculiar appearance.

The cell is the adult fat type which dominates the picture except for a slight amount of connective tissue which contains the blood vessels.

Neurogenic fibromas occurring in the bone, are osteolytic in character. Through expansion, they may perforate the cortex and distend the periosteum. Nerve symptoms are not usually a feature. As there is gradual transition from the benign to the most malignant forms, the benign tumor should receive radical treatment. Neurogenic sarcoma is extremely malignant, recurs promptly, and should be treated radically by excision of the jaw.

Microscopic study of the neurogenic fibroma shows wavy nuclei in elongated cells arranged in inter-twining bundles and whorls. They have a tendency to form fibrillae, as can be demonstrated with special stains. Histologically they are related to the more common subcutaneous neurofibromas and show no palisading as is seen in the schwannoma. The neurogenic sarcoma is made up of spindle cells and may also show marked fibrillar structure and faintly staining myxomatous substance interspersed among bundles of spindle cells. Tumor giant cells may be present. The most malignant tumors contain pleomorphic nuclei and spindle-shaped cells with sharply pointed nuclei that are packed closely together, crowding out the myxomatous areas.

The myxoma is usually a central tumor. In the peripheral form it occurs as an osteomyxoma or chondromyxoma. It consists of yellowish white translucent tissue with a moist, sticky surface. On microscopic examination it is seen to be made up of stellate cells with long processes or cells that are triangular or fusiform. They are contained in a mucoid matrix made up of fine fibrils forming a delicate meshwork.

The chondroma of the jaws is a rare tumor. It occurs as an outgrowth from the bone surface or as a central tumor. Virchow, von Recklinghausen, and Borst have shown that rickets is an important fetal disturbance predisposing to irregularities of bone growth with formation of chondromas.

Chondromas are made up of hyaline cartilage, but in most cases the cells are rounded and irregularly arranged. Transitions into bone cells may occur and give rise to osteoid and even true areas of bone. The growing cells are not in the center, but in the periphery of the tumor and thus in their progressive growth they are in a position to infiltrate and become malignant.

Imperfect islands of bone may be seen throughout the tumor. In some cases, the cartilage formation is imperfect and mucinous material is produced. Calcification and ossification are also seen, especially in tumors that have ceased to grow. These may be named ossifying chondromas or osteochondromas.

An osteoma may be made up of compact bone, in which case it is named osteoma durum, or it may contain a spongiosa in the center, when it is spoken of as osteoma spongiosum. The osteoma may be peripheral or central in location. The latter is spoken of as endosteal osteoma and is not easily distinguished from a cementoma.

The osteoma forms a circumscribed, hard, ossified tumor, which may attain a very large size. The surface is often extremely hard and has an ebony-like appearance. Two other types seen are the multiple osteomas and the fibro-osteoma.

True lymphoblastomas are tumors which form from the lymph nodes or wherever lymphoid tissue exists. The lymphoblastoma forms from lymphoblasts in lymph nodes, adenoid tissue, and lymphoid tissue in the submucosa.

Lymphoma may form a solid tumor mass of firm consistency, revealing a tendency to ulcerate on the surface exposed to the mouth. It may consist of a single node or several fused together. It is encapsulated and, after reaching a certain size, remains stationary for months or years. From this benign type, there are various stages of malignancy.

It appears gray and translucent on section. The microscopic picture is typical. There is a diffuse growth of uniform lymphoid cells which is in contrast to Hodgkin's disease with its heterogeneous mixture of cells.

The angioma is a tumor composed of either blood vessels or lymphatics. The tumors, therefore, are spoken of as hemangiomas and lymphangiomas.

The hemangioma is formed from endothelial rudiments or from the endothelium of blood vessels. New vessels form in the shape of capillaries or cavernous spaces, and we therefore speak of capillary and cavernous hemangiomas.

Lymphangioma is formed from the endothelial cells that line the lymph vessels in a manner similar to that of hemangiomas. The endothelial spaces, instead of containing blood, are filled with serous fluid.

The lymphangioma occurs principally on the tongue, but it may be found on the lips or neck.

Fibrosarcoma is defined by Anderson as "a malignant tumor tending to differentiate in the direction of fibrous connective tissue". He says that fibrosarcoma is most common in the fifth and sixth decades although it may occur at any age. This neoplasm more often occurs in the lower extremities and appears as a rounded, lobulated mass and may appear to be encapsulated or circumscribed.

Whether or not the fibrosarcoma is hard or soft will depend on the amount of connective tissue present.

There are several different types of fibrosarcoma. Some of these are: central fibrosarcoma, neurogenic fibrosarcoma, peripheral fibrosarcoma, and odontogenic fibrosarcoma. The authorities do not agree on the exact classification.

The liposarcoma is a malignant tumor that is of a lipomatous nature. This tumor usually contains enough fat that it can be recognized. The malignant tumor usually contains a large number of granular cells or smaller polyhedral cells. This is a rare type of cancer which is composed of embryonic fat cells and will not be discussed in detail.

The myxosarcoma is a tumor composed of epithelial and endothelial cells which have become incorporated. This type tumor contains many more cells and more vessels with less matrix than the simple myxomas. As a rule, there is mucous tissue which is associated with areas of fine spindle cells, often grouped about blood vessels.

The neurogenic sarcoma originates from the sheaths of the nerves and is characterized by cells of variable size and shape arranged in an interlacing herring-bone pattern. This tumor possesses a high degree of malignancy. Neurogenic sarcoma of the breast is said to be of rapid growth and therefore is a quick destroyer of this part of the body. The cells in these tumors of the breast are found to be numerous, large, and multinucleated.

Chondrosarcomas resemble the benign cartilaginous tumors called chondromas but tend toward malignancy. They differ in that the malignant type assumes a softer texture and grows faster.

Osteogenic sarcoma is a common malignant tumor of the bone being found near the epiphysis in the shaft of the long bone. The more malignant osteogenic sarcomas are not often found in the oral region. The majority of the osteogenic sarcomas arise beneath the periosteum, apparently from both sides of the shaft. The age group in which this tumor is usually found is between ten and thirty years. When it is found in older people the prognosis is better. The microscopic picture of this type of tumor is generally rather uniform and its chief feature is the production of immature and atypical bone, cartilage and osteoid tissue by the pleomorphic tumor cells. The cells are hyperchromic spindle, round and polyhedral. The inter-cellular material may be reduced to a thin hyaline strand of globules. Polyhedral cells are usually present and the number of cells usually indicates the degree of malignancy, the greater the number of cells the more malignant the condition is.

This group of tumors is difficult to diagnose, so great care should be taken in the study of such conditions.

Myosarcoma may be divided into two different classes, the leiomyosarcoma and the rhabdomyosarcoma, the former being a tumor having the characteristics of smooth muscle. These tumors are not of usual occurrence and a pure rhabdomyosarcoma is considered rare. In the oral cavity, the rhabdomyosarcomas are usually found in the tongue and the palate. These tumors are radioresistant, invasive, and tend to recur even after surgery, but are slower to metastasize than the usual malignant tumor.

Lymphosarcoma is usually found in people of the approximate age of forty-five. These growths arise from any mass of lymphoid tissue. Most commonly involved are the cervical lymph nodes but often involved nodes are found in the gastro-intestinal tract. There are two types of lymphosarcoma: malignant lymphocytoma and reticulum-cell sarcoma. These tumors are not often found in the oral cavity but lymphosarcoma of the tonsil has been reported. This condition affects only one tonsil, generally with a poor prognosis.

The angiosarcoma is relatively rare concerning the oral cavity, and therefore will not be discussed. It is a sarcomatous mass made up almost entirely of blood vessels.

Two groups of tumors comprise the undifferentiated sarcoma: the spindle-cell tumor and the round-cell tumor, being of atypical character and diagnosed chiefly by the nature of the composition. These tumors are highly malignant: 60 per cent recur and 25 per cent become generalized.

Where tissues of different character occur together in the same growth, they are termed mixed tumors. This is unusual in that tumors are comprised of one type of cell except in the mixed tumors and teratomas. Occurrence of these tumors can be in any part of the body, but usually they are found in the salivary glands and kidneys. Metastasis is very low, being about 25 per cent. To definitely diagnose the mixed cell tumor, various parts of the tumor should be taken because no two mixed tumors are the same in histologic structure. They all have different morphologic composition. Occurrence is usually in the young age group but because of the slow interosseous development they may be present for years before the host discovers their presence.

The word teratoma literally means monster, and from the description, it is fitting Teratomas are rare and the damage done is by the extension of the tumor The ovary and testicle are the most common sites of occurrence. Prognosis is good if the diagnosis is early. The unfertilized cells of the ovary and testicles are thought to be the predisposing cause of the tumor. The cells start to grow

and try to form a new individual. If the right conditions were possible, a complete individual could be formed. The composition of these tumors is complex and often lacks orderly arrangement. Although this tumor is not often found in the mouth, cases have been reported in which teratomas were located in the mandible, and maxilla, in which many teeth were found. These, however, are not true teratoma but are most often termed odontomas.

Since tumors or neoplastic growths are of such broad scope, it is impossible to discuss in detail the various types and their manifestations. In this chapter, our discussion of each neoplasm has been limited to a brief description, sites of occurrence, and degree of malignancy. Naturally, the more frequently occurring neoplasms of the oral cavity were more fully discussed, as it is believed that the general practitioner, or average dentist, should be impressed to a greater degree so as to encourage him to familiarize himself with these lesions, thereby allowing a more accurate and rapid diagnosis.

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5

Methods of Cancer Diagnosis

THERE is little doubt in the minds of those men who daily see the reaction of patients who are reluctantly informed that they are hosts to the cancer lesion, that it is the most dreaded and feared of all diseases.

With the ever increasing number of cases of neoplastic growths confronting the population of the universe, it behooves all engaged in the practice of the healing arts to become more cognizant of the profound incipiency of this deadly menace. The old adage of an ounce of prevention being worth a pound of cure stands true here from the point of view that the early recognition and diagnosis will certainly be of utmost aid in bringing about the conquest of this monster. In many cases early treatment can bring about certain cure.

The diagnosis of cancer is not obtained by any single method or approach, but rather by a combination of data, interrogation and knowledge of tissue reactions and their variations. This is by no means a small task, but one based on sound research and knowledge.

To effectively recognize and diagnose cancer there are three criteria that are essential to a scientific conclusion, namely: (1) A well-formulated, accurately obtained and planned case history. (2) An accurate microscopic and macroscopic analysis of neoplastic tissue changes. (3) A knowledge and utilization of analytical diagnostic procedures.

It is to this end that the following paragraphs will be attempted with elaboration on the three diagnostic aids that will enable the clinician to more conscientiously and scientifically recognize and ultimately treat neoplastic growths.

In order to be proficient in this he must have a thorough knowledge of all types and variations of the types of all malignancies, both subjective and objective, and the diseases from which they must be differentiated.

One of the prerequisites of understanding any study in detail is first to have a basic outline or formula of approach. A simple, yet complete, classification of tumors, made up by combining classifica-

tions previously given by Ginn and Anderson, divides them into the following varieties:

TUMORS OF MESENCHYMAL ORIGIN

Origin or type of cell

Fibrous connective tissue
Peripheral nerve sheaths
Fatty tissue
Myxomatous tissue
  (as in umbilical cord)
Cartilage
Bone
Muscle
  smooth
  striated
Notochord
Lymphocytic tissue
Serous linings
Blood or lymph vessels
Neuroglia

Benign form

Fibroma
Neurofibroma
Lipoma
Myxoma
Chondroma
Osteoma
Myoma
  leiomyoma
  rhabdomyoma
Chordoma
Lymphoma
Angioma
Glioma

Malignant form

Fibrosarcoma
Neurogenic sarcoma
Liposarcoma
Myxosarcoma
Chondrosarcoma
Osteogenic sarcoma
Myosarcoma
  leiomyosarcoma
  rhabdomyosarcoma
Lymphosarcoma
Mesothelial sarcoma
Angiosarcoma
Gliosarcoma
Undifferentiated sarcoma
  small round cell sarcoma
  large round cell sarcoma
  mixed cell sarcoma

TUMORS OF EPITHELIAL ORIGIN

Benign

1. Papilloma
2. Adenoma
3. Ameloblastoma

Malignant

1. Squamous cell carcinoma
2. Basal cell carcinoma
3. Adenocarcinoma
   (*a*) mucoid carcinoma
   (*b.*) scirrhous carcinoma
   (*c.*) carcinoma simplex
   (*d*) medullary carcinoma

MIXED TUMORS

A. Benign B. Malignant

TERATOMAS

A Benign B. Malignant

From the above classification it is obvious that the diagnosis will be facilitated, the nomenclature simplified, and the subsequent treatment planning and therapy expedited.

It is also an essential factor in successful diagnosis and recognition of cancer to secure a knowledge of the clinical and microscopic features of the pathological process. Therefore, the follow-

ing discussion concerning the individual tumors is important relative to this manuscript.

Fibromas are of fibrous connective tissue origin and are composed of bundles of interlacing collagenous fibers. They are widely distributed but most commonly found associated with tendons, subcutaneous tissue, and skin, but also may be found in organs with a high percentage of connective tissue. A fibroma is usually a small mass which is singular and has the same general appearance as the surrounding tissue. The surface is smooth and usually the tumor is spherical. It is normally not pedunculated and is relatively asymptomatic unless it interferes with some structure or organ through size.

The myxoma is a tumor composed of mucous tissue. A primary myxoma composed entirely of mucous tissue is very rare but other tumors arising from mesenchymal origin often contain myxomatous portions. Myxomas are soft, lobulated papillary tumors. Upon section they show a smooth glistening gelatinous-like surface. They have a generous blood supply and the vessels are large with few capillary attachments. They are seldom encapsulated and tend to infiltrate the surrounding tissue. Microscopically the tumorous tissue is composed of star-shaped and spindle-shaped cells interspersed with droplets of mucus. The myxoma is a slowly growing tumor which presents no symptoms except local swelling and pressure. Upon complete surgical removal they do not recur but due to the infiltrating type of the growth this is often difficult Myxomas occur chiefly where the subcutaneous tissue and muscular layer are loose, and there is an abundance of fat. The regions most affected are the thigh, neck, cheek, and peritoneum.

The lipoma is a tumor composed of fatty tissue. These tumors are firm, elastic, rounded and usually multilobulated. Although they are not usually encapsulated they are well defined from the surrounding tissue. They may vary in size from that of a pea to great masses weighing many pounds The microscopic picture resembles fat tissue, but the cells vary greatly in size and the connective tissue stroma is irregular in distribution The subcutaneous tissue is the most common site of the lipoma and is frequently seen in the back, neck, shoulder, axilla, and abdominal wall They also occur on the hands and may be associated with the tendinous sheaths. Lipomas are usually asymptomatic except through mass or pressure.

Chondromas are neoplasms arising from cartilagenous tissue The tumor is a hard, rounded, lobulated growth which may reach a large size. The growth of the tumor arises from several growth

centers and as the rate of growth is varied convolution similar to brain tissue is produced. These are usually surrounded by perichondrium and are composed entirely of cartilage. The majority of chondromas occur in early life and are congenital. The most common location is at the ends of growing bones. At the completion of growth they show a definite inhibition. They may produce skeletal disturbances due to interferences in growth and development of the bones of the body.

Chordomas are tumors which arise from the remnants of the chorda dorsalis. They are usually seen in the infant in the centers of the intervertebral discs. They seldom reach a large size and are so soft as to be asymptomatic.

Osteomas are a circumscribed overgrowth of bone tissue and occur in such a wide variety of situations that they have never been definitely defined. They are usually spontaneous or traumatic but seldom arise from inflammatory reactions. They may be divided into three general classes:

1. *Exostosis.* – Circumscribed enlargements which project above the bony surface.
2. *Endostosis.* – Enlargement which lies in compact or cancellous bone.
3. *Hyperostosis.* – Diffuse enlargement of bone.

Secondary osteomas occur in many tumors where they are the result of ossification of the connective tissue of these neoplasms.

Myomas are tumors of muscle tissue origin and are divided into two types: Leiomyoma, containing smooth muscle tissue, and rhabdomyoma, composed of striated muscle tissue. Leiomyomas occur in the form of single or multiple firm and opaque or cystic tumors usually found in pre-existing smooth muscle tissues. They may be hard or soft depending upon the amount of connective tissue present. The leiomyoma upon section presents characteristic striated or convoluted muscle bands, but is more opaque than normal tissue. It is usually sharply circumscribed and may be readily peeled out of its capsule. The uterus is the most common seat of the leiomyoma but it may also occur in the gastro-intestinal tract or in any other place where smooth muscle is present.

The rhabdomyoma is a tumor of striated muscle and is very rare primarily but is often secondarily associated with other tumors. Rhabdomyomas are varied as to size and shape, but histologically are similar. They present a system of parallel bundles of striated muscle fibers supported by adult or embryonic connective tissue. The course of the rhabdomyoma is progressive enlargement; it is

encapsulated in the adult form and nonencapsulated in the embryonic forms.

The angioma is a tumor formed of new vessels; it is divided into two classes: the hemangioma, composed of blood vessels, and the lymph angioma, composed of lymph vessels. These tumors are composed of almost normal vessels and are pathological only in location, size and number.

The sarcoma is a malignant tumor derived from connective tissue and is classified as to the type of tissue from which it arises.

The fibrosarcoma is a widespread tumor which is very common. It may be found in any place where supportive connective tissue is found. These tumors are usually single and are rounded with poorly marked borders. The tumor is hard in the small growths and becomes progressively softer as the growth progresses. The growth is rapid, and spontaneous cessation of growth is rare Local recurrence after removal is common and early metastasis is frequent The cellular structure resembles fibroblasts but the cells are much smaller and closely packed.

The osteogenic sarcoma is composed of osteoblastic cells which can be derived from the inner layer of periosteum or from the endosteum. This is the most common tumor of bone. It is most commonly found in the shaft of the long bones, but may occur in any of the bones of the body. It is highly malignant and rapidly fatal. It may present a picture of bone destruction or bone formation. The cellular picture is complex and difficult to describe. The condition is radiologically diagnostic in later cases, but may be only vaguely suggestive in early cases. Medullary sarcoma arises in the bone marrow, and produces a distention and thinning of the cortex of the bone to such a great degree that spontaneous fracture is common. The onset is insidious and the symptoms vague. Roentgenographs are suggestive but are not to be relied upon as cysts, osteomyelitis and other benign lesions must be ruled out. The tumor contains giant cells as well as large and small round cells. It is not so malignant as the periosteal type and its extension is slower and metastasis is not so frequently found.

Neurosarcoma is a highly malignant tumor arising in the subcutaneous or deeper nerve trunks. These tumors are large and grow rapidly. At first they are movable but as they infiltrate the skin, fascia and muscles they become bound down. These tumors are not encapsulated and are difficult to excise, so local recurrence is common. The structure of the tumor presents characteristic intertwining of the spindle cells and nerve filaments.

Lymphosarcoma is a very malignant tumor made up of large round lymphoid cells. Its most common site is in the tonsillar area. It is not encapsulated and it invades the surrounding tissues, especially the lymphoid tissue. The extension to adjacent lymph vessels is rapid, but metastasis also occurs through the blood vessels. Thus far there is no cure and surgical interruption leads to recurrence.

The melanosarcoma is one of the most highly malignant tumors known. It is composed of pigmented cells similar to the cells of the rete mucosum. The melanosarcoma resembles the carcinoma in its extension to adjacent tissues and lymph nodes. It is one of the most rapidly growing and earliest metastasizing tumors known.

The term papilloma is applied to local outgrowths of tissue which are composed of the local lining tissues. The papilloma has been grouped into four classifications: (1) an inflammatory hyperplasia, (2) an overgrowth of normal tissues, (3) an overgrowth of atypical tissues, (4) distinctly atypical and malignant overgrowth of tissues The course of papillomas is usually benign and self-limiting. The tumor is asymptomatic except when it extends into and occludes a body cavity.

The adenoma is an organoid tumor which reproduces the structures of a gland. The tumor may contain all of the structures of a gland and even have some limited function, but may vary by having only a very slight amount of glandular tissue and no function. The tumor is usually a well-circumscribed, encapsulated growth which shows no tendency to infiltrate the surrounding tissues. Adenomas are usually polypoid in shape and are slow growing and self-limiting. As they have an abundant blood supply they are not prone to degeneration or ulceration.

The ameloblastoma or adamantinoma is derived from epithelium that has the power to differentiate into enamel epithelium without actually forming enamel. The ameloblastoma is usually found in the molar region of the mandible but may be found in the maxilla or even widely distributed portions of the body. It is usually partially encapsulated and is rarely malignant. It may be found either with or without dental tissue contained within it. The lesion is demonstrative by roentgenography but must be differentiated from several other lesions.

The malignant epithelial tumors form a very important group because of their frequency and serious results. They are distinguished from benign epithelial tumors because they invade and destroy normal tissue and spread by metastasis. Carcinomas differ in the degree to which they imitate their tissue origin. Sometimes they

closely resemble the tissue from which they arose while at other times it is difficult to distinguish them from embryonal tissues, but all of them show at least some of the following characteristics:

1. Cellular overgrowth indicating abnormal powers of proliferation is one of the outstanding characteristics of many carcinomas.
2. Atypical qualities of the cells – although there is no typical morphology of the cancer cells they all show definite changes from the original cells.
3. Heterotopia is the invasion of the epithelium beyond its normal limits and is usually easily discernible in almost all types of carcinoma.
4. Local invasive and destructive properties are accomplished in all types of carcinomas. It may be by single cells or groups of cells or it may be such an invasive force as to resemble an infection.
5. Desmoplastic properties are one of the most significant factors regarding carcinoma in its ability to produce proliferation in the connective tissue underlying it In fact, this may be effected before the epithelium itself has undergone any change and is very diagnostic.
6. Loss of polarity – this disturbance in the relationship of one cell to the other is usually seen in advanced cases of carcinoma. Complete loss of cellular relationship to surrounding cells is seen which presents a picture of advancing malignancy.
7. Metastasis – it is a highly significant property of carcinoma to give rise to cell emboli which produce similar lesions in distant parts of the body.

The degree of cell differentiation serves as a criterion to grade the individual cancer as to rate of growth, chance of recurrence and danger of metastasis. Broder's classification follows.

Grade I. (Slowly growing type) – Differentiation from 100 to 75 per cent and undifferentiation from 0 to 25 per cent.

Grade II. – A carcinoma in which differentiation ranges from 75 per cent to 50 per cent and undifferentiation from 25 to 50 per cent.

Grade III. – Carcinoma in which differentiation ranges from 50 to 25 per cent and undifferentiation from 50 to 75 per cent

Grade IV. (Rapidly growing type) — Carcinoma in which differentiation ranges from 25 per cent to almost 0 and undifferentiation from 75 to 100 per cent.

The basal cell carcinoma occurs most frequently upon the skin of the face and is much less malignant than the other forms of carcinoma. This tumor forms exclusively from the basal cell layer of the stratum malpighii. The tumor seldom infiltrates the deeper structures; it spreads peripherally and grows slowly. It

usually presents itself as a small round ulcer with a raised indurated border. The lesion is seldom fatal and proceeds by direct extension and may destroy a large area.

The squamous cell carcinoma arises from the squamous cell layer of the epidermis. The tumor may form a papillary erection upon the surface of the skin or may form columns which extend down into the connective tissue underlying it. The surface may become cornified and often ulcerates. The cells may be polar or non-polar and show keratinization with epithelial pearls being present in the more slowly growing types. The connective tissue stroma varies greatly: in the rapid growing infiltrating carcinoma there may be little; in the more slowly growing types a great deal of new connective tissue may be found.

The transitional cell carcinoma develops from the epithelium of lymphoid tissue. It usually forms a papillary growth with a broad pedicle or base. These tumors are highly malignant and metastasize early.

The adenocarcinoma may form a papillary tumor which is invasive, but more often is seen as a lobulated growth of firm consistency which forms a deep-seated lump that can be felt upon palpation. This form usually remains unnoticed until it breaks through and ulcerates. The appearance and arrangement of the tumor cells vary greatly, depending upon the type gland from which the tumor arises and the stage of malignancy which the growth assumes.

Thoma states that the teratoma is composed of tissue and organs of one, two or three germinal layers. Occasionally teratomas resemble embryos and are called embryomas. Generally, they reproduce parts of the body in abnormal locations. These are, therefore, of complex, compound structure, and the newly formed tissue may be of embryonic or adult type. The complexity combined with the relative variety of this tumor does not warrant discussion in this brief chapter.

A most valuable aid to the diagnostician in recognizing and reaching an affirmative answer is the biopsy. The biopsy displays greatly the relationship between microscopic structures and prognosis and the relationship between morphology and radio-sensitivity. The former relationship is more accurate in the extremes, that is, if the cancer is of quite low or exceptionally high malignancy. For tumors of medium degree of malignancy the decision is more difficult. And, as in any biologic studies, the prognosis is subject to errors and pitfalls and varies directly with the experience of the pathologist. In regard to the latter relationship, it is important for the clinician to recognize the tumor as radiosensitive or radio-

resistant. It would be a serious matter to perform a surgical procedure upon a lesion which is sensitive to irradiation. Therefore, as stated, the biopsy should be used as an aid and the information obtained from its microscopic study should be interpolated into the diagnosis of cancer.

The principal purpose of the act of biopsy is to obtain tissue for microscopic examination and diagnosis.

In making a decision as to whether or not to perform a biopsy in a given case, certain general facts can be used as guides. However, it must be kept in mind that biopsy is only one method in diagnosing a case and each must be treated individually. The first of these general rules applies to ulcers. If the lesion is already ulcerated and consequently infected, there is no objection to introducing such infection into the area. Also, as in any surgical procedure, it is undesirable to cut through normal tissue, the tissue is already far from normal, so here again there is no objection. Therefore, we do not hesitate to perform a biopsy in these cases. The second general rule applies to the encapsulated tumor. It is accepted that it is undesirable to break down what is probably a natural barrier to the extension of the disease. In these cases excision rather than incision should be practiced. The third consideration deals with the degree of malignancy of the cancer. In general, a highly malignant tumor should not be incised. This seems contradictory since one of the prime purposes of the biopsy is to determine the degree of malignancy and radiosensitivity, but if clinical evidence is highly indicative of a great degree of malignancy we must adhere to this rule as closely as possible. If it is mandatory to have a definite diagnosis by means of biopsy, it is in many cases preferable to administer preoperative irradiation as a precautionary measure. The fourth consideration is that of accessibility. It is obviously no trouble to obtain a biopsy from a friable ulcerated lesion of the skin or mucous membrane, but imagine performing a biopsy upon a deeply situated central osteogenic sarcoma. This would necessitate going through several layers of normal tissue and in actuality constitutes a major operation within itself. Therefore, every means should be employed to diagnose the case without biopsy if there is great inaccessibility Fifth, the importance of a definite prognosis must be considered This is of great psychological value to the patient, especially if all the clinical evidence points to the presence of an incurable lesion In general, wherever possible, the diagnosis of an incurable lesion should be supported by microscopic evidence. Lastly, the most important single practical question that should always be considered in connection with biopsy is

whether the findings will influence the therapeutic procedure. If, for example, the contemplated procedure is one of radical surgery or massive irradiation, the diagnosis, whenever possible, should be confirmed by biopsy. On the other hand, if the diagnosis needs to be clarified only as to which of two fatal processes exists, it is futile and useless to perform a biopsy, unless there is ready access and also if there are special indications.

There are various methods of performing the biopsy as follows:

1. Incision
   - *a.* By scalpel
   - *b.* By electrocautery
   - *c.* By high frequency cutting current
2. Punch biopsy
3. Curettage
4. Paracentesis
5. By aspiration
6. Sponge method

A technic for taking a biopsy with a scalpel is as follows:

The areas chosen for the operation should be cleansed and washed with 70 per cent alcohol. The cautions observed here should be not to disturb the surface or cause bleeding and, by all means, not to use an antiseptic such as iodine that would cause discoloration or alter the staining characteristics of the tissue.

The anesthetic of choice is local anesthesia if the lesion is on the mucous membrane. Ethyl chloride may be used if the lesion is on the skin but injection local anesthesia is preferred since it does not freeze the surface and if the tissue is unfrozen it is more easily removed. When using local anesthesia by injection avoid injecting directly into the site of the lesion as the pressure produced may alter the histologic picture of the tissue later dissected for use in the microscopic study.

A thin scalpel, a pair of fine dissecting forceps, needle, and scissors are the instruments needed. An elliptical incision is made in the direction of the lines of cleavage of the skin and extended deep enough to include the cutaneous and perhaps normal tissue. The tissue should now be gently raised with the forceps and dissected away. Always make a vertical incision before attempting to cut across the base of the tissue so as to cause as little damage as possible. The lesion may or may not be sutured, especially if the lesion is small, and along the cleavage lines of the skin there is no need for sutures.

In order to minimize the bleeding it may be desirable to use the cautery method in highly vascular tumors. The high frequency

cutting knife is also used in taking specimens, but the cautery and the high frequency knife must be used with great care so as not to destroy or damage the specimen by dehydration or charring. These are used when the specimens are large and there is no danger of penetration of the heat to the core of the section and as mentioned in highly vascular tumors.

The punch forceps are utilized when the section is not to be very large and the location is relatively inaccessible, *i.e.*, such regions as the maxillary sinus and lateral or posterior pharyngeal wall.

The curettage method is used in the removal of tissue from the depth of bony cavities, sinus tracts, etc. The material obtained by the curet is treated, embedded in paraffin and sectioned in the usual way.

Paracentesis is a method in which a bony cavity is punctured and the fluid is tapped. The fluid is centrifuged and the cells are embedded and stained in the usual manner.

Aspiration is accomplished by using a needle with a large lumen and a syringe or apparatus to provide a strong negative pressure. The needle is inserted into the area under surveillance, and a strong negative pressure is exerted by the syringe so as to draw the fluid or cells into the lumen of the needle. The matter is then expelled from the needle and prepared for microscopic examination as before. This method is very useful in examining any nodes, cysts, tumors, and tissues that are not easily accessible by means of the usual incisional methods, because they lie so deep in the body.

The anatomical structure and chemical composition of the sponge are very important in the success of the sponge method of biopsy. The sponge must have the ability to absorb cells, fluid, and tissue when the surface of a suspected lesion is rubbed. It must be able to resist any solvent, such as alcohol, acetone, etc. that may be used to prepare the obtained material for study. Also, the sponge must be of such material that it may easily be sectioned.

First, the ulcerous lesion is wiped with dry sterile gauze. Then, grasping a properly sized sponge with forceps or clamps, the ulcer is gently rubbed. The size of the sponge depends upon the area in question and the accessibility. Flat, rectangular-shaped pieces are usually used. As soon as the sponge becomes thoroughly saturated with the tissue fluids and fragments it is treated with the ordinary procedure to obtain microscopic sections.

This technic offers advantage in that the tissue does not suffer excessive trauma and in cases where accessibility is difficult it has met with great success. Through chemical studies by various cancer

clinicians the sponge method of biopsy has been proven to be practically as good an aid to diagnosis as the surgical biopsy.

After a surgical biopsy is performed the wound should be cauterized with electrocautery, with 50 per cent solution of zinc chloride, with phenol, or with Carnoy's solution, a sclerosing solution usually employed in treating cysts and fistulae. For practical purposes this affords the patient protection by hemostatic action of cauterization.

Numerous ideas have been propagated concerning the apparent danger of hastening metastasis by the local irritation of a biopsy. However, the consensus of opinion among recognized leaders is that the occurrence and the severity of the complications and dangers are slight as compared with the value of the knowledge obtained with such a procedure. Stout states, "There is far more danger to the patient by not confirming the diagnosis than there is a possible spread of the cancer by cutting into it". Thoma states, "No suspicious lesion can be pronounced harmless without microscopic examination".

The *x*-ray may also be utilized in the diagnosis of cancer. This aid will display any bone destruction, rarefaction, or condensation, and may indicate the use of a biopsy or possibly indicate the need of a pathologist to make frozen section studies during the surgical treatment of the cancer.

Another important aid to the diagnostician in the recognition of cancer is a careful and thorough evaluation of a complete and accurate case history. Due to the insidious nature of the majority of neoplastic conditions, this topic is an adjunct, although a valuable one, in the correct diagnosis of cancer. It is a must that a differential diagnosis be a part of the scientific type lesion determination, to arrive at the correct diagnosis, for ultimate treatment and prognosis of case progression.

The length of the case history is unimportant, but it must contain data pertinent to the case on hand or data that by some obscure pattern may be related to the ailments of the patient.

In the patient examination the first data to be recorded should be name, sex, race, occupation, and other facts of the same nature that appear on the standard patient form chart.

Of course, the primary factor about which all other examinations and questions should be centered is the patient's present prevailing complaint. The symptomatology should be first obtained in the patient's own words and then recorded with any notation necessary. At this stage of the examination the natural senses of touch, sight hearing, sound, etc. should be made good use of. At this point it

is best to make use of such questions as when, where, how, how long, type, pattern of pain, recurrence, etc., for they will be of great value in the elimination of other disease entities.

A careful and complete physical examination should be performed and should include the following factors:

1. Careful oral examination, paying particular attention to the floor of the mouth, tonsillar crypts, and buccal and labial folds of tissue, the lips, the tongue, and the cheeks.
2. A complete examination of the patient without clothing.
3. Palpation of the breasts.
4. Abdominal palpation.
5. Examination of the external genitalia.
6. Rectal examination, both external and internal, including palpations of the bladder and prostate gland.
7. A careful inspection of the cervix through a vaginal speculum.
8. A bimanual pelvic examination.
9. Thoracic, abdominal, and oral *x*-rays.

In the gross examination of the patient particular attention should be paid to the skin, to take into account all rough, scaly pigmented nodules and moles. Any nodular, non-inflammatory lesions should of a certainty be taken into consideration and be closely observed. Inflammatory lesions of any type should be examined and ulcerations, especially those located in areas of more or less obscure positions, be closely observed. If any one of these conditions appears to be neoplastic to any degree a biopsy should be taken.

That there are many theories to the cause of cancer goes without statement. However, it must be borne in mind by the clinician that the past history of the patient will bring to light many important and pertinent facts about the case on hand that by chance may be overlooked in a quick and incomplete examination that neglects to take them into account. These facts, if traced far enough by the examiner, may often be proven to be of some etiological importance.

The occupation of the individual often spreads light on the possibility of occupational hazards of pre-cancerous exposure. There may be occupations that cause constant irritations by chemicals, irradiations or actinic ray activity of the sun.

A family history may bring attention to certain hereditary anomalies that could be mistaken for acquired manifestations.

To be able to arrive at some positive and accurate conclusions in neoplasm diagnosis, there are certain definite tissue reactionary manifestations that must be differentiated, such as hyperplasias, inflammatory and repairing proliferations, and maldevelopments

of hypertrophied tissues, notorious in that they mimic neoplastic growths in their own manifestations.

The differential diagnosis associated with inflammatory proliferation can be recognized to be of a different type than that of neoplastic growth in that the inflammatory process is a reaction of the body to a stimulus of some sort that sets up a clear-cut clinical picture of irritation, redness, heat, swelling, inhibition of function, and pain, and leads to formation of granulation tissue and ultimate healing. When the stimulus is removed the lesion tends to heal itself.

Another condition that must be differentiated from neoplastic growth is that of hypertrophied tissue reactions. Under this heading we list those of maldevelopment and congenital malformations such as clefts, port-wine stains, benign pigmented moles, and the great majority of angiomas. They are easily differentiated by their gross appearance and static condition as to growth.

True hyperplasia is differentiated from neoplastic growth in much the same way as is inflammation in that it is a compensatory response to a loss of tissue, or to meet functional demands by the proliferation of cells. It is limited in amount and duration only to meet the above requirements.

There are various diseases that must in many cases be ruled out before an accurate diagnosis of cancer can be ascertained: namely, syphilis, tuberculosis, lymphadenitis, and actinomycosis, to mention a few.

Syphilis must be borne in mind whenever there are lesions about the face and genitalia, for any of the stages of this disease may exhibit lesions that could easily be mistaken for a neoplasm.

The chancre of the primary stage usually appears in one of three locations. the hands, lips, or about the genitalia. However, the blood Wassermann, the Kahn test or the dark-field picture will easily and quickly differentiate this disease from a neoplasm. This can be said also of the mucous patches and gamma of the second and third stages respectively.

The differential diagnosis for tuberculosis is also one of a fairly easy determination even though the lesions may appear to be quite neoplastic in nature. A tubercular lesion may be microscopically examined for the presence of the tubercular bacillus, or in active cases of the pulmonary type, the hemoptysis of frank blood coupled with râles in the upper right apex of the lung and presence of tubercular bacillus may be of great differential diagnostic value.

One of the most difficult processes to distinguish from neoplastic hyperplasia is simple hyperplasia of the lymphoid tissue. Due to the ready response to irritation such as inflammatory hyperplasia,

the relative mobility of lymphoid tissues and the ameboid accessibility to both the blood and lymph paths make lymphadenitis a frequent and difficult process to distinguish from neoplastic growth. In these instances unless regression occurs in a very short period, a biopsy should be taken to determine the exact histopathological picture and arrive at a correct diagnosis.

The differentiation between benign and malignant tumors is of paramount importance in the accurate diagnosis of cancer. In the brief discussion which will follow, the benign characteristics will be taken up first and then those of the malignant form.

Clinically, the benign tumors appear as expansive, slow growing tumors that are usually encapsulated and do not often kill the individual unless they encroach on vital organs of the body and inhibit their function. They do not metastasize and seldom recur after removal. The benign tumors rarely become necrotic or ulcerate and do not produce cachexia.

Histologically, the benign tumor may be said to consist of well-differentiated cells of rather uniform size and shape that exhibit little mitosis and the nuclei of which take up stain normally. There is a fair imitation of the arrangement of the tissue from which they are derived. The cells do not infiltrate.

A clinical picture of the malignant tumor forms has a very great difference and by use of these few points, can be differentiated with relative simplicity. Clinically, the malignant form is a rapid, non-encapsulated invasive tumor that metastasizes readily. Due to this last fact it readily recurs after removal. The lesion often becomes necrotic, ulcerates and kills by its invasiveness and destructiveness. It produces cachexia and anemia.

Histologically, the malignant tumors consist of poorly differentiated anaplastic cells that exhibit polymorphism to a great degree. The nuclei of the cells stain hyperchromatically. There is presence of numerous, multipolar mitoses. There is an unsuccessful attempt to imitate the arrangement of the tissue from which they are derived. The cells do exhibit a great degree of infiltrative power.

Diagnosis of neoplasms based upon statistical investigation is important and should merit consideration. Upon this basis they have been divided into four grades:

Grade I is diagnosed by means of a simple, physical examination. This is the type diagnosis utilized by many general practitioners and is purely guess-work with little if any reliability.

Grade II utilizes special methods such as roentgenograms, operative procedures and pathological technics other than the study

of excised tissue. This technic also has its shortcomings but is in wide use in practices and hospitals.

Grade III utilizes the above two types and also has the added advantage of examinations of excised tissue. This is a more reliable form of diagnosis provided the area of biopsy is sufficient and the pathologist is competent. Metastases in this case as well as *Grade I* and *II* are not revealed and therefore in this event would be unreliable.

Grade IV makes use of the necropsy and is considered the best method of diagnosis. However, since this is a postmortem examination, the patient obtains little, if any value from it. It only serves to add to the total sum of knowledge on the subject and possibly aid in future correct, early diagnoses.

From the foregoing conclusions it might be postulated that as goes the diagnosis, so goes the progress of neoplastic growths. Without a well-organized, scientific correlation of the three main criteria for cancer recognition that have been elaborated on in this chapter, a positive, well-formulated and scientifically based solution for cancer diagnosis would be to no avail. The correct and absolute diagnosis means that another step has been taken to add new fuel to the faintly burning fire of cancer conquest.

To the above a conclusion might then be stated that the subject of cancer is a serious one and "methods of cancer recognition" should be studied with great diligence by every practitioner entertaining the possibility of contacting this disease. For upon us rests the responsibility of early diagnosis which may mean the extension of a patient's life.

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6

Biopsy

THE term biopsy simply means the removal of tissue from a living subject for microscopic examination and diagnosis. The section of tissue removed may be large or small, it may be an entire tumor or only a portion thereof. In any case it should contain some of the surrounding normal tissue for best results in diagnosis. The final diagnosis and planning of a rational program of treatment is usually based on the microscopic examination of the tissue from the growth. The biopsy is of greatest value in small lesions or early malignancies but even in most of the late lesions valuable information as to the type and degree of malignancy is obtained by the microscopic examination.

The biopsy is an important adjunct in the diagnosis of many diseases and lesions, but the failure of its use through negligence or overconfidence is often seen. Perhaps the reason for this is the lack of appreciation of its importance and the fact that many practitioners consider it a rather formidable procedure. However, more and more importance is being placed on the value of the biopsy and it is becoming a universal diagnostic aid, for it is impossible to always correctly diagnose neoplastic and inflammatory lesions from the history and clinical appearance alone It can be said without fear of contradiction that for a disease to be properly treated it must first be properly diagnosed, and it is in the matter of diagnosis that histologic study is often so invaluable.

Biopsies were mentioned by several men in the literature before the middle of the nineteenth century, however, there was no rational foundation for its use as a diagnostic aid in malignancies until 1854 when Virchow advocated it. He believed that by a biopsy examination he could then completely excise the tumor in its early stages and get complete eradication of it. Later in his life, Virchow became skeptical of the superiority of the microscopic examination over the gross pathologic examination and diagnosis. It is felt that this skepticism from a man of such great authority and influence had much to do with hindering the progress and use of biopsy.

True recognition of the value of the biopsy only came early in the twentieth century and was due largely to the works of Wilson, Bloodgood, Ewing, MacCarty and Wood Many surgeons still opposed its use as late as 1917, but the majority did favor its use with certain restrictions and conditions.

Usage has tended to restrict the term "biopsy" to the examination of tumor tissue suspected of having malignant tendencies. It is realized that accurate diagnosis and prompt selection of the correct therapy for neoplastic diseases are necessary if cancer mortality is to be reduced. Biopsy gives more certain results in the diagnosis of cancer than other available methods. However, it should never replace or precede other clinical methods of diagnosis, but should be used to supplement them by confirming or disproving the clinical diagnosis. Often a small section of tissue will suffice for a positive diagnosis, but in the case of a suspected neoplasm a negative diagnosis of the biopsy should not lead one to take this as conclusive evidence. In this case, another biopsy should be taken and examined.

The fear of dissemination of malignant and pre-malignant cells from trauma during biopsy has haunted the medical field for a long time and seriously impaired the recognition and treatment of cancer. Back in 1917 when a drive was under way to submit biopsy specimens to the New York City Health Department, physicians rose in protest and flooded the newspapers and magazines with articles and editorials highly deploring the practice. Leading surgeons of the day even went so far as to say it was a criminal act.

This misconception was partially brought about by the fact that medical schools stressed the theory that the capsule in which a tumor was embedded served as a barrier along with the normal tissue surrounding it, and any trauma or disturbance which broke this barrier generally led to rapid metastasis of the malignant cells by direct invasion of the adjacent tissue and metastasis by blood and lymph vessels.

This theory has been outmoded and highly modified by a number of men in the field of cancer research. It is believed that metastasis may precede capsular formation and that it can occur anytime during the life of the tumor, that the amount of cells transplanted to other parts of the body by way of blood and lymph and the vulnerability of the tissue invaded would be factors in the metastasis of the cells. They also believe that a few cells transported to distant parts of the body might be overcome by tissue defenses whereas a large number could not be coped with by normal tissue; therefore,

if part of or all of the malignant cells are removed by biopsy the chance of metastasis would be reduced.

The histologic examination of oral lesions in clinical interpretation cannot be overemphasized. It is not possible to interpret neoplasms and inflammatory lesions properly on clinical appearance and history alone, thus the biopsy is becoming a universal diagnostic aid. In any lesion, a proper diagnosis and prognosis is essential in order to rationalize treatment properly. The number of cases on file with the Registry of Dental and Oral Pathology in which malignancy has been proved by the use of the biopsy emphasizes the merits of the procedure.

Since the danger of biopsy is still a highly controversial question, experiments with laboratory animals have been conducted. The tumors used were transplanted several times and checked in the laboratory so thoroughly that a 100 per cent predictability of their growth could be determined. The rats selected were a group of homogenous inbred stock to prevent any error in tissue susceptibility.

Peterson and Nuttall conducted an experiment with squamous cell carcinoma which they transplanted into two groups of rats consisting of 166 rats. One group was used as a control; the other group was biopsied without regard to trauma. They found at the end of a two-year period that there was no difference in the amount or degree of metastasis between the two groups.

Under a separate experiment, four separate groups of rats were used with a control series in each group. In the first group a highly malignant fibrosarcoma was transplanted into the control as well as the non-control group. Nine days later the tumors from the non-controlled group were excised. The results of this experiment showed 19 of the control lived twenty-eight days after inoculation, whereas the experimental series which had their tumors incised lived forty-two days after inoculation. At postmortem the weight of the tumor mass from the controlled group averaged 21 grams, 79 per cent of the controlled group had lymph metastasis, and 90 per cent lung metastasis; whereas the average weight of the tumors from the non-controlled group was 34 grams, lymph metastasis 84 per cent, and lung 63 per cent.

In the second series, a cystadenocarcinoma of the mammary gland was injected into 20 rats, and sixty days later biopsies were performed on the experimental series. The results of this experiment indicated the rats of the control group survived an average of ninety-eight days, average tumor weight 24 grams, 26 per cent lung metastasis; whereas the experimental group lived an average

of one hundred twenty-five days, average tumor weight 15 grams, 60 per cent lung metastasis.

For the third experiment a mixed tumor of the mammary gland was used. After twenty-two days a simple biopsy was performed on the experimental group. The results of this work showed that the 20 rats of the control series lived an average of one hundred ten days, average tumor weight 61 grams, 20 per cent lung metastasis; whereas the experimental group showed an average survival of one hundred thirteen days, average tumor weight 39 grams, 22 per cent lung metastasis.

For the fourth experiment, squamous cell carcinoma was injected into the prostate gland of the rats. Of the 34 rats of the control series, the average survival was ninety-three days, and 91 per cent lung metastasis; whereas in the experimental group the average daily survival was ninety-five days, with 90 per cent lung metastasis.

From these reports it is indicated that the life expectancy can be increased by the removal of any part of a neoplasm. In the valuation of this material it should be remembered, however, that the gross or microscopic features of cancer in man differ from laboratory animals, and the results of trauma from biopsy of malignant cells in man might respond differently from that of experimental animals.

From the literature studied, it seems that after careful examination and a thorough clinical history of the patient, giving due consideration to the tentative plan of treatment to follow, practically all suspicious lesions should be biopsied in order that a more definite treatment might be instituted and scientific knowledge obtained concerning the deadly disease which annually claims the lives of about 200,000 Americans.

Clinical diagnosis of a lesion is not sufficient in many cases. The lesions of syphilis, cancer, tuberculosis and some of the dermatoses such as lichen planus and pemphigus may appear in the mouth in forms which are atypical presenting a complicated diagnostic problem.

Clinically it is extremely difficult to differentiate between squamous cell carcinoma and basal cell lesions, yet the difference in prognosis and treatment is of greatest importance. The problem of differentiating leukoplakia from early cancer and other benign tumors from malignant tumors is likewise of importance. The biopsy is probably the simplest and most accurate aid to correct diagnosis.

Histological examination should determine if a lesion is neoplastic, granulomatous or if it is a simple inflammatory process.

It may also determine if the lesion is a tumor and what type of tumor If the tumor is malignant the possible degree of malignancy may also be determined.

The biopsy is invaluable to the general or oral surgeon in the planning of his treatment. Treatment based upon tissue diagnosis can be made along specific lines, depending upon his judgment, experience, or available facilities.

In oral surgery, one of the most useful applications of the biopsy is in establishing a positive diagnosis of inflammatory processes by excluding neoplastic or specific infectious diseases which resemble them clinically. The frequent lesions of trauma, chronic irritation, and related disturbances common to the oral cavity often have characteristic manifestations.

Syphilis is not ordinarily considered a disease in which a biopsy is necessary for diagnosis and treatment. However, in a broad sense the dark-field examination of primary lesions may be considered as a type of biopsy. In the secondary stages of syphilis this type examination may prove even more valuable than serologic examination.

It is in the later stages of syphilis that the biopsy plays the most important role. Gummatous lesions of the tongue, maxilla, mandible and other parts of the oral cavity may be very similar to other infections and inflammatory lesions. In these circumstances histological examination is necessary for diagnosis as serologic tests are not reliable. Leukoplakia of syphilitic origin may also be confusing and has a tendency to progress to epidermoid carcinoma. Tissue diagnosis is imperative in lesions which have such a trend and do not respond to local treatment.

Tuberculosis may present secondary lesions in the mouth which are of concern to the oral surgeon. Although the clinical symptoms of pulmonary tuberculosis are present, a biopsy is necessary for a correct diagnosis of these oral lesions Tertiary tuberculosis may present metastatic foci in the oral cavity even though the pulmonary lesions are in an arrested stage. These lesions may be found on the tongue, cheeks, lips, gingivæ, or alveolar ridges and the sputum still give a negative test

In many cases of tuberculosis the pulmonary stage may be overlooked and secondary lesions may arise in the mouth. These lesions may be bulky and be suggestive of cancer or they may ulcerate and resemble syphilitic lesions. To determine the correct diagnosis and direct treatment, tissue studies may be of great value to both the dentist and the patient.

The histological examination of the apical granuloma has been of value in research. Information from such studies has been obtained regarding the histogenesis and pathogenesis of epithelial odontogenic lesions such as radicular cysts, ameloblastoma and epidermoid carcinoma.

Leukoplakia and lichen planus are two diseases with similar clinical appearance. However, it is very important that these two be differentiated, as leukoplakia may be a precancerous lesion whereas lichen planus is of a less serious nature. By the histological examination of specimens from these lesions it is possible to differentiate them.

Both lesions are similar even upon microscopic examination. The characteristic features of both are their keratotic activity of the prickle-cell layer and chronic inflammation. The distribution and intensity of these reactions provide a means of microscopic differentiation.

The enumeration of the various tumors and their histological characteristics would be a field too wide to undertake in a paper of this nature. The biopsy as has already been stated is an invaluable means of diagnosing such neoplasms and determining the prognosis and treatment.

Bone diseases of the maxilla and mandible of the rarefying and sclerosing types may give roentgenographic features which resemble neoplasms of either osteoblastic types. Osteomyelitis may resemble fibromata or even osteogenic sarcoma. Bone abscess may resemble granulomata or cysts. Biopsy can differentiate neoplastic and inflammatory processes and guide surgical intervention or conservative measures.

Sequestra are natural biopsy material and should be carefully examined. Tissues adhering to extracted teeth may give indications of underlying or adjacent inflammation or neoplastic disease of the bone. Biopsy should also be made on tissue removed from a socket that is prolonged in healing.

Certain other tissue removed during an operation may be natural biopsy material in itself. Some examples of these are:

1. In extractions there may be some soft tissue and/or bony tissue attached that might be of some diagnostic aid if examined by microscope.

2. Pieces of hypertrophied soft tissue might be wholly excised if they are not too large.

3. Granulation material from a tooth socket may be examined.

4. In removal of cysts, granulomas, polyps, epuli and other tumors, it is advisable to have a microscopic examination made.

Biopsy of the gingival tissue has been used as a means of finding deep necrotic foci of infection in gingivitis. Repeated gingival biopsies also make it possible to check the effectiveness of various therapeutic measures.

Recently the gingival biopsy has been used in the diagnosis of generalized amyloidosis. Amyloidosis occurs as a complication of numerous diseases including syphilis, rheumatoid arthritis, traumatic wounds, Hodgkin's disease, malignant tumor, ulcerative colitis, and bronchiectasis. Most often it is observed as a complication of tuberculosis.

Amyloid is a protein material which is widely deposited in the tissues of the body accompanying one of the foregoing diseases. It affects almost all parts of the body, especially the kidneys, pancreas, liver, lymph glands, heart, adrenal glands, thyroid, prostate, blood vessels and spleen. When present, it may cause difficulty or dysfunction of the organ.

The ease of obtaining biopsy material from the gingiva and its great power of regeneration and its resistance to infection make it a promising method for the diagnosis of amyloidosis. The failure, however, to find amyloid in the gingival tissues does not rule out the disease.

It should not be inferred that tissue analysis alone can provide a correct diagnosis in every instance. While occasionally the results obtained are quite dramatic, it is essential that sound clinical judgment on the part of the clinician be employed. While it is often possible to estimate the character of a lesion by the behavior and appearance of the cells, their deviation from normal with respect to staining, and their relation to normal tissue, it is of greatest importance to understand that such information alone cannot provide the complete answer in every instance. The effect of radiation, especially repeated doses, may definitely complicate the problem of microscopic diagnosis. It is important, therefore, that the clinician be aware of this problem in interpreting the report from the pathologist. Further, the location of a lesion may often influence the decision of the clinician regarding the taking of a biopsy. The inaccessibility of deep lesions of bone may cause the procedure to become a major operation, which in certain cases is contraindicated. The decision must be made for each individual case.

The material in the center of a lesion is frequently amorphous or necrotic tissue debris without any definite histologic characteristics. For this reason, it is usually best to select the most indurated area of the periphery to include with the normal tissue adjacent

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ceives sections which tell him nothing of the lesion. A specimen of tissue from the border of the lesion but still containing a portion of the lesion itself should be taken. The biopsy should extend into the normal tissue surrounding the lesion so that the pathologist can determine the changes taking place at the periphery. Where possible, papillomatous growths should be removed entirely, so that any changes which may be taking place at the base may be studied. In obtaining a lymph node for study, one should be selected that is definitely involved rather than one at the periphery that is easily removed.

In preparation for the removal of the specimen, a tray with the necessary instruments and medicaments should be prepared. This should include novocaine and syringe, suture needle and thread, needle holder, scalpel handle and blades, tissue forceps, suture scissors, gauze sponges, and a bottle of fixation solution. These instruments should all be sterile and in orderly arrangement on the tray.

In most biopsies of the oral cavity there is usually no need for excessively deep anesthesia. Two per cent novocaine such as that used in exodontia is sufficient. The use of ethyl chloride is not advised in most cases since the freezing of the tissue might expand and rupture some of the cells. The area to be excised should be cleansed with alcohol and a sponge. Iodine is not used because of its staining characteristics. The injection is made in the normal tissue at the edge of the area to be excised.

There are several methods which one may use in obtaining tissue for microscopic study. These are:

1. Excisional – by means of scalpel, cautery or the radioknife.
2. Incisional.
3. Various punch methods.
4. Curettage.
5. Paracentesis – with examination of fluids from body cavities for tumor cells.
6. Aspiration.

From the standpoint of the pathologist the excision of the entire lesion is most desirable for examination. From a clinical standpoint those small lesions of the mouth (those not exceeding 1 cm. at the greatest diameter) are best handled by complete excision and the microscopic examination. By such a method the pathologist is then able to determine whether or not the entire lesion was removed. When removing a lesion of this type one should include a generous amount of normal tissue around the periphery and carefully close the defect with sutures. As has previously been

to the lesion. As Cooper has stated, the lesion is likened to a pie and he advises "lots of crust" on the specimen.

When a condition which is deserving of a biopsy presents itself there are certain general rules to be considered. A representative picture of the lesion should be secured; in other words, a section of tissue showing all or the greater portion of the whole pathology should be taken. For example, a thin deep section including normal tissue at the base will show the invasion of the lesion, whereas a broad shallow section will not. It is always best to include normal tissue at each end and at the base of the section if possible. Many technics require the use of forceps in holding or removing the specimen. During this procedure great care should be taken to avoid crushing the specimen. Also, if the electric knife is used in the removal, care should be taken not to distort the tissue by heat and dehydration. Should the lesion be located externally on the face, the section should be taken from a shadow line if possible for esthetic reasons. Whenever multiple lesions are present a section should be taken from each to determine the method and degree of progression. The size of the tissue section should not be smaller than ⅛ × ⅛ × ⅛ inch. Instead of attempting to remove a section from a very small lesion the whole lesion should be removed.

When taking a biopsy from a tumor of the breast, bone or thyroid, the surgeon should have the patient ready to immediately remove the lesion if the frozen section shows it to be malignant. Biopsy of the lips, skin and oral pharynx are less dangerous and a reasonable length of time may safely elapse before treatment is instituted. If a melanoma or melanosarcoma is suspected, incision or incomplete biopsy should never be done, but the lesion should be widely, deeply and completely excised.

Before a biopsy is taken the area should be washed and thoroughly cleansed with 70 per cent alcohol. The operator should be careful not to disturb the lesion or cause bleeding in the cleaning process. Bernier states that iodine should never be used in sterilizing the area, as it might alter the staining characteristics of the tissue.

Great care must be taken in selecting the site for biopsy. In cases where the lesions are multiple, sections may be taken from several lesions and different stages of growth studied. If the lesion is on the face, care must be taken to prevent unnecessary scarring.

In small lesions that can be removed entirely, the entire nodule may be used for a biopsy specimen If at the time of biopsy the entire lesion cannot be removed, great care should be used to obtain a satisfactory specimen. Too often, the pathologist re-

ceives sections which tell him nothing of the lesion. A specimen of tissue from the border of the lesion but still containing a portion of the lesion itself should be taken. The biopsy should extend into the normal tissue surrounding the lesion so that the pathologist can determine the changes taking place at the periphery. Where possible, papillomatous growths should be removed entirely, so that any changes which may be taking place at the base may be studied. In obtaining a lymph node for study, one should be selected that is definitely involved rather than one at the periphery that is easily removed.

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mentioned, the other notable use of excision biopsy is in the case of suspected melanoma or melanosarcoma.

Although the entire lesion is most desirable from the standpoint of the pathologist, it is generally considered to be safer to remove only small sections for microscopic examination in most cases.

Incision biopsy is the type most frequently used in the oral cavity. The removal of a tissue specimen is done simply, painlessly, is inexpensive and can be done with little time and effort. The incision technic is very simple and actually requires less surgical knowledge than most extractions. There are a few principles, however, which must be borne in mind, for the site from which the biopsy is taken is important and requires careful study. It should be repeated that the material in the center of the lesion is often necrotic and amorphous and has no definite histologic characteristics; therefore in selecting the site of the biopsy, one should select the most indurated area of the periphery and include both parts of the lesion and normal tissue for comparative purposes. The area should be cleansed with 70 per cent alcohol and novocaine injected into the adjacent normal tissue. The incision should be elliptical, starting at the center of the lesion and extending into normal tissue. It need not be more than 2 or 3 mm. in width but should always extend deep into the subcutaneous tissues. Care must be exercised in removing the specimen to avoid altering the cellular structure by means of crushing. In small sections no sutures may be necessary but sometimes in larger ones sutures are taken.

Sometimes it is desirable to make a biopsy by means of the cautery method instead of the scalpel. This is especially true of highly vascular tumors, for this method is valuable in minimizing the bleeding at the site of the biopsy and blocking the lymph spaces. It must be used cautiously to prevent destroying the diagnostic value of the tissue due to dehydration or charring. It is generally best to limit this method to large sections so the heat will not penetrate to the center of the specimen. The use of the cutting current and not the coagulating current is helpful in diminishing the destructive effects of burning and distortion.

Perhaps the simplest method of taking a biopsy is the punch biopsy by means of punch forceps. These are special forceps designed to take a bite of tissue. This has a marked disadvantage on skin lesions, however, for it leaves an open wound that cannot as a rule be sutured. Thus, these areas must be kept clean to prevent infection and allowed to fill in with granulation tissue which leaves the subsequent scars. The punch forceps are very useful in removing tissue from inaccessible regions such as the

maxillary sinus and the lateral or pharyngeal walls. Martin recognized the fact that the removal of a specimen by the conventional biting forceps from a firm or dense tumor, especially when covered by intact mucous membrane, may traumatize the growth and be painful for the patient. With this in mind he devised a set of instruments with detachable punches of various sizes which resemble an ordinary leather punch. This instrument is used on the anesthetized tissue by several rotary movements until it penetrates to a depth of 5 to 6 mm. and then the instrument is removed. The specimen is then held with forceps while the base is severed with a pointed scalpel or biting fork. This has the advantage of leaving a small neat circular depression rather than a larger, more painful bite. This instrument has been particularly recommended for biopsies of non-ulcerated, non-friable tumors in the oral cavity and pharyngeal wall.

Curettage is seldom used for biopsy in the oral cavity due to the accessibility and ease of using other methods. Sometimes it may be advisable to use this method to obtain tissue from the depth of a bony cavity, sinus tract or maxillary sinus.

Aspiration is a useful method of examining tissues such as lymph nodes, cysts, tumors, and deeply located tissues not easily accessible by the usual methods.

Burford states that the only indication for aspiration biopsy in the general practice of dentistry is those cystic lesions of the jaws in which clinical and roentgenological findings have not completely removed the possibility of anything other than a simple cyst. The aspiration method is used here due to the possibility of an ameloblastoma which might become secondarily infected following an incision biopsy. The technic used in a case of this type is as follows: Anesthetize the area and cleanse with 70 per cent alcohol. Make an incision to the bone with a Bard Parker No. 11 blade. Then with the plunger down in a 50 cc. syringe to which has been attached a 15-gauge needle, pass the needle through the bony plate into the cystic area. When the needle is felt to be free of resistance, start a clockwise and counterclockwise rotation of the needle while withdrawing the plunger. Try to include the approximate center of the cystic area in the needle, then when the needle feels to be free from tissue the plunger is slightly relaxed before withdrawing the syringe. With a stilet for the needle, the tissue is gently forced on a piece of absorbent paper and all is placed into some fixation solution to be sent to the pathologist.

McLean describes a helpful technic of aspiration biopsy in soft tissue. He uses an obturator in the needle lumen which is left in

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or gauze which is saturated with the formalin solution. The tissue specimen is then placed in the center of this and shipped to the laboratory. In all cases that are shipped, the bottle should be well corked and sealed with paraffin. If the material is not shipped it can be taken directly to the laboratory in the original formalin solution.

Most tissue diagnoses throughout the country are made from paraffin sections. Rapid frozen sections are very important when the patient is still on the operating table and further operation depends on microscopic diagnosis. This is most important in breast and soft tissue tumors. Many errors have been made in attempting to diagnose frozen sections in a few minutes. It is always a wise procedure for the pathologist to set aside enough of the biopsy specimen to make paraffin sections later.

If a satisfactory study cannot be accomplished by the use of frozen sections, the surgeon, if possible, should close the wound and wait for paraffin sections before proceeding with an extensive operation.

Adequate clinical information should be submitted to the pathologist when the tissue is submitted so that he can properly weigh the microscopic findings. Often tissue cells which are abnormal in one area of the body may be normal in some other part. The minimum clinical information should be the age of the patient, the location, size, and general appearance of the lesion, and the clinical history and tentative diagnosis when possible. Such information may be of great value to the pathologist who is expected to make a diagnosis. Too often the pathologist receives nothing but a bit of tissue and the patient's name. This makes accurate diagnosis in many cases very difficult or even impossible.

SUMMARY

Members of the dental profession hold a position of unique advantage in the early diagnosis and prevention of cancer of the oral cavity. Tumors commonly occur in healthy persons who may seldom need to see a physician, at least for any complaint which would require a thorough examination of the oral cavity. The dentist sees most of his patients once or twice a year for a thorough examination of the teeth and during this examination he should inspect and palpate the tongue, floor of the mouth, gums, palate, and cheeks, and note on his record any departure from normal. Should the dentist detect anything that would point to cancer or a precancerous lesion, he should either take a biopsy or recommend

place until the needle reaches almost to the area of the tumor capsule. The obturator is then removed and a syringe attached to the needle to obtain negative pressure. By this method two important things are accomplished. First, the obturator prevents the lumen from filling with fat and fibrous tissue before the tumor area is reached, thus getting a report of "fat only" or "fat and fibrous tissue" from the pathologist. Second, by starting the aspiration just outside the tumor capsule and progressing inward we may get that area around the periphery which is sometimes only a narrow fringe and the only portion diagnosable as cancer. Wilson emphasizes the point that suction should be maintained during the entire withdrawal of the needle in an aspiration biopsy due to the possibility of injecting or depositing tumor cells in the tissues on the way out.

Although aspiration biopsy is often considered a poor and uncertain method of obtaining good biopsy specimens, Sayago made a study on 34 patients with known cancer and got a positive result in 82.4 per cent of the cases by aspiration biopsy. This 17.6 per cent failure in aspiration biopsy can usually be attributed to one of the following three causes:

1. The point of the needle not entering the tumor.
2. The structure of the tumor being so fibrous as to make aspiration into the needle difficult.
3. The aspirated material being falsely interpreted.

With the aspiration method of biopsy the relationship of the neoplastic tissue to the normal tissue cannot be determined and the diagnosis of cancer from this method is therefore based upon cytological examinations.

Under no circumstances should a biopsy specimen be allowed to dry. Before a biopsy is done, a suitable container and fixing fluid should be available. The tissue should be placed immediately into the fixative before there is destruction of the structural detail. According to Ford, Zenker's solution is best for small biopsies if they are not left in the solution for more than twenty-four hours. Larger pieces or small ones that will not reach the pathologist within thirty-six hours should be placed in 10 per cent formalin. The specimen should never be placed in water. This results in swelling and distortion of the cells. Alcohol is a poor fixative and causes marked hardening and shrinkage of the tissue.

According to Bernier the tissue specimen is immediately placed in 10 per cent formalin and allowed to remain for twenty-four to thirty-six hours. The tissue is then removed and the fluid emptied from the bottle. The bottle should be packed loosely with cotton

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and refer the patient to a cancer surgeon for such. It has been proven many times that the dangers of biopsy are far outweighed by its benefits.

Diagnostic failures are often caused by the removal by the dentist or physician of an inadequate specimen which is sent to the pathologist. If the biopsy is not representative it may give a false sense of security with a false diagnosis. The specimen should contain some actively growing tumor and some of the normal tissue and not be taken solely from the necrotic portion of the tumor. For incision biopsy a good rule is "thin and deep rather than broad and superficial". Excision biopsy is usually performed when the nodule is less than 2 cm. in diameter. For lymph nodes, excision is the procedure of choice.

Several methods of removal of the tissue have been used but the best is by the use of the sharp knife. The cautery deforms the cells' structure and staining quality and sometimes suggests false neoplasm. Crushing of the tissue by forceps should be avoided if possible.

Fixation of the specimen is a very important step, whether formalin or Zenker's solution is used. The specimen must be placed in the solution as soon as removed and not allowed to dry. Formalin is best if the specimen is to be mailed

The pathologist needs descriptive data along with the biopsy. To get the benefit of the pathologist's interpretation of the relation of the specimen to the disease in a patient, the name, age, sex, race, duration of disease, exact location of the specimen, and its relation to other lesions, size and state of ulceration of lesion, laboratory findings, and details as to previous radiation and surgical treatment should be included in the information.

The pathologist's report concerns only the specimen he receives A negative report can be used as evidence against neoplastic disease, not in the patient, but only in the tissue examined. If clinical evidence indicates neoplasm, then take another biopsy.

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the predominance of blood vessel invasion by sarcoma as compared to carcinoma. In many cases by the presence of rapidly growing and swollen tumor tissue, the tumor cells appear to be mechanically forced into the veins. The entry of the tumor cells into veins may be accomplished by one of several ways; by invasion and rupture of adjoining vessels, through the defective vessels within the tumor or by infiltration along the vasa vasorum and intima with gradual erosion of the wall. Tumor emboli that enter the portal vein or its collateral circulation tend to lodge in the liver. This organ is the most common site for the tumor to metastasize from the gastro-intestinal tract due to the blood stream connection between these two organs.

Tumor emboli from systemic veins tend to develop in the lung. These emboli in the lung often die out. They become coated with fibrin and fail to become implanted sufficiently to develop into a metastatic growth. Secondary tumors of the skin often come from the melanoma, while secondary tumors of the bone usually come from the breast, prostate, kidney, lung or thyroid.

It is quite evident that environment plays an important role in cancer metastasis. Some organs are more prone to have secondary tumors through metastasis than other organs. Some tumors seem to have a special predilection for several organs, while other organs seem to have an immunity from these tumors. The muscles are often flooded with malignant emboli and yet it is a rare case when a secondary tumor is found in the muscles. Cancer metastasis also takes place by implantation. Carcinoma of the ovary commonly spreads throughout the peritoneal cavity in this fashion. The tumor cells involving the serous or mucous membrane of this organ become detached and are later implanted on other areas. It is not understood why blood borne metastasis has an affinity for the liver, lung and bone and is uncommon in the heart, spleen and voluntary muscle. It has been noted that metastases to the brain are usually from the lung, breast, stomach and prostate.

Continuity metastasis is the spread of a malignancy to some adjacent structure by continuous spread or direct contact of those surrounding structures. In many cases this type of metastasis may involve many structures and corrective surgery may become quite complicated. It has been observed that the larger local growths are usually more benign, and if the growth has spread to an adjacent excisable or resectable structure, it should not prevent the surgeon from doing a radical resection, provided distant metastases are not found. It is not rapidity of surgery that is of prime importance in one of these operations, but rather a careful accurate dissection with

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Metastasis of Cancer

METASTASIS is a process in which a secondary tumor appears at some distance from the primary growth and which may represent one of several events. These secondary tumors have absolutely no connection with the original or primary neoplasm. It may mean a multiple origin, and a new tumor; or a continuous extension from the primary growth; or a true metastatic growth arising by lymphatic permeation, by the blood stream or by implantation.

Carcinomas spread more commonly by way of the lymphatics Many researchers believe the tumor cells grow into lymphatic channels and are broken off and carried as emboli to a lymph node, usually a regional lymph node. The tumor cell lodges in the node, grows until it overwhelms the node, breaks the capsule of the node and spreads locally and on into the lymph system to some distant node. Microscopically, at this stage, the cells may be demonstrated in the sub-capsular space and the peripheral sinus of the nodes. Handley points out that there may be lymphatic spread by permeation, that is, by direct and continuous growth along a lymphatic channel. The prediction of the course of metastasis that a given tumor will take is based upon two sources of information, anatomical and microscopic diagnosis and accumulated experience regarding the usual behavior of the lymphatic channels.

Thus a secondary tumor is initiated which may not only spread onward in the lymphatic system, but may overwhelm the node and spread laterally. It may also be formed by permeation as in the breast or by direct extension. Even though permeation probably does occur, lymphatic embolism appears to be more common

Sarcomas metastasize more commonly by way of the blood stream. Cells from the malignancy penetrate the thin walls of a vein The cells may then break off and become emboli Blood vessels are frequently invaded by carcinomas also, as it has been shown that epithelial tumors demonstrate a remarkable capacity to flourish in and travel through the veins. The abundance of thin-walled blood vessels, the presence of naked sinuses, and the tendency toward necrosis and hemorrhage rather than fibrosis, may largely explain

Squamous cell carcinoma, or epidermoid carcinoma, as it is sometimes called, is one of the most malignant types of cancer, and as such, is dependent upon an early diagnosis for successful treatment. Since it is the dentist who is frequently the first one to note the beginning of this malignant condition in the oral cavity, the greater amount of the responsibility is upon him to institute treatment that will arrest the condition before it can become cancerous; or, if it is already malignant, to refer the patient to a surgeon who will begin immediate treatment. Squamous cell carcinoma rapidly metastasizes, and an early involvement of the submaxillary, submental, and cervical nodes of both sides may be noted even though the tongue may be involved on only one side. Metastasis to the regional lymph nodes causes them to hypertrophy and become hard due to the increase of fibrous connective tissue. A hard and fixed lymph node is almost always considered pathognomonic of cancer. If the membrane lining the node is penetrated or broken through, the gland becomes adherent to the surrounding tissues. Cancer of the left side of the face may first show evidence by the invasion of the lymph nodes on the right side of the face. This may be accounted for by the anastomoses of the lymphatic chains in and around the area of the neck. The primary lesion may be eliminated and showing no signs of recurrence, but metastases may have progressed further up the lymph chains in which evidence may not be shown until months later. At first, there is a barely discernible enlargement of one or more lymph nodes. As the disease progresses, the metastatic cervical masses, sometimes bilateral, may steadily increase in size up to 10 to 15 centimeters in diameter. A progressively enlarging metastasis eventually perforates the capsule of the node, enabling the disease to infiltrate the soft parts of the neck to involve adjacent structures. Invasion of the cervical nerve roots by cancer produces severe intractable pain, and impairment of function will result from involvement of the hypoglossal nerve (paralysis of one-half of the tongue), vagus nerve (hoarseness), etc. As the disease metastasizes, the entire side of the neck, floor of the mouth, or the mandible may become solidly encased by the tumor, producing a huge ligneous mass. Cancerous lymph nodes may become infected, producing bulky, fluctuant, liquefied abscesses.

As has been previously mentioned, cancer can metastasize from any part of the body to any other part of the body, and it follows no pattern or routine. Thyroid tumors occasionally metastasize to the jaws. Carcinoma of the gastro-intestinal tract with metas-

a minimum amount of trauma and blood loss, thus reducing the operating shock.

There are innumerable classifications of malignant tumors today with the diagnosis of malignancy positive. Boyd originated a method of grading malignant tumors according to their radiosensitivity into three main groups: (1) Highly radiosensitive: lymphosarcoma, multiple myeloma, lympho-epithelioma, embryonal carcinoma; (2) Moderately radiosensitive: epidermoid carcinoma, carcinoma simplex, depending in each case on the degree of anaplasia, (3) Highly radio-resistant: fibrosarcoma, osteosarcoma, neurosarcoma, melanoma, glioma, adenocarcinoma (except adenocarcinoma of the thyroid).

There is also another classification which is of great value. It grades the malignancy according to its size, extent and degree of metastasis. The classification consists of four stages. The first stage is composed of only local lesions which are 2 centimeters in diameter. The second stage consists of probable metastasis as evidenced by destructive invasion of local tissues or enlargement without fixation of the lymph nodes. In stage three the lesions have definitely metastasized to regional lymph nodes or proliferated into the adjacent or surrounding structures. Stage four is far advanced and one which has metastasized beyond the regional lymph nodes and has progressed beyond the possibility of cure by surgery or radioactivity therapy.

Oftentimes it becomes difficult to differentiate a metastatic tumor from the parent tumor. The primary tumor may be larger than the metastases in some instances or the metastases may be larger than the primary tumor, therefore, size is of little value in distinguishing between the two. Histologic examination may be used in some instances to determine which is of primary origin, but when the cells are poorly differentiated histologic examination cannot be used as a determining factor.

Another factor which may be of value in differentiating between the two types of tumors is the fact that the metastasis is usually less invasive, has a more regular outline, and may be encapsulated, whereas the primary is more invasive and has an irregular outline. Some tissues have a special predilection for metastasis while primary tumors are rarely found in these tissues; an example of this predilection is the liver.

One method of metastasis that is often overlooked is the dislodging of the tumor cells by trauma or by massage. The tumor cells are less cohesive than normal tissue. therefore making them easier to dislodge.

in both legs dating back to a previous hospitalization due to diabetes. X-ray of spinal cord revealed changes in the ninth and tenth dorsal region. The patient was confined to bed. Weakness was more marked in the lower left extremity. Pain was also present along margins of the ribs. Codeine and acetylsalicylic acid were first administered for relief. Later morphine had to be resorted to.

A thorough examination was given. Blood pressure was 180 systolic, 80 diastolic, temperature 99.6° F., pulse 95, and respiration rate 20 per minute. The teeth were dirty and in poor condition. The head and chest were negative and the heart was normal. Abdominal examination was negative. A lumbar puncture revealed a clear fluid with 53 red cells and 8 lymphocytes per cubic millimeter, a two plus (2+) Pandy reaction and a negative Wassermann. No metastasis was revealed by *x*-ray in the skull or pelvis. However, the 10th dorsal vertebra revealed a neoplastic metastasis. Chest *x*-rays showed hypoventilation of the lower lobe associated with primary bronchogenic malignancy.

A laminectomy was performed on the eighth, ninth and tenth dorsal vertebrae. The patient's condition was poor at the end of the operation and he died two days later.

The clinical diagnosis of this case was carcinoma of the bronchus with metastases to the tenth dorsal vertebrae, and diabetes mellitus. Autopsy revealed a small mass projecting from the gums behind the lower right bicuspid. Numerous translucent gray masses were found on the peritoneal surface of the bladder and liver. Both lungs were crepitant. Hilar nodes were enlarged and firm, revealing on cross-section an opaque foci of metastatic carcinoma. No metastatic carcinoma could be found in the bronchi or bronchioles. Metastatic nodules were noted in the pancreas, liver, adrenals, kidneys and the right lobi of the thyroid adjacent to the trachea. There was also metastasis in the lymph nodes near the celiac axis. The anatomic diagnosis was carcinoma of the right bronchus with metastasis to the abdominal and thoracic lymph nodes, liver, lungs, kidney, adrenals, diaphragm, thyroid, bladder, bodies of the ninth and tenth dorsal vertebrae, spinal cord compression and dilation of the urinary bladder. The secondary lesion was found to be epulis by the pathologist. This case reveals tremendous metastasis of an innocent malignant tumor and the damaging result of death if left undiagnosed.

Oral surgeons and surgical orthopedists do not speak of cures, but believe that if one year of healthful, comparatively comfortable activity to the life of a useful man can be maintained, a great accomplishment has been obtained. Care must be exercised else the

tasis to the jaws has been reported to occur from primary lesions in the stomach and rectum.

In the presence of cancer of the lip, we find metastasis to the regional lymph nodes is encountered in a varying percentage of cases. Metastasis depends chiefly on the extent and activity of the lesion, as well as the presence or absence of treatment. In general, it may be stated that with cancer of the lip, metastasis follows by way of the lymphatic vessels, the cervical and sublingual nodes. In a report by Bernier of 29 cases of primary carcinoma of the lip, there was metastasis in 26 cases to the regional lymph nodes, in 1 to the peribronchial nodes, 1 to the adrenal glands, and 1 to the liver, spleen and lungs. It must be remembered however, that Bernier's findings were on autopsy material and the statement is not generally applicable. Carcinoma of the lip, if extensive, may involve the bone of the mandible by direct extension, or by entrance through the mental foramen.

If the malignant growth in the mouth and in the neck is not controlled, and if the patient survives long enough, metastasis frequently occurs to some viscus below the clavicle, such as the lungs, liver, or the bones.

The latest surveys show that about 7 per cent of all cancer deaths are caused from those malignant growths arising in the oral cavity. Most of these cases reported are primary cases; however, it has been shown in a table compiled by Stern and Shepard that in rare cases malignant growths do metastasize to the bones of the head.

In many of the cases of mouth cancer the primary lesion is silent and the first symptom that the patient may notice is a lump in the neck. Often the patient's physician will send him to the dentist, thinking the swelling may be caused from a dental abscess. The dentist should be on the alert for such cases, since early detection is a prerequisite for cancer cure.

Martin points out that in mouth cancer the primary lesion may be only a few millimeters in diameter, yet there may be metastasis to the cervical lymph nodes.

An interesting case reported by Burket reveals the extensive metastases an undiagnosed primary carcinoma of the gingiva can reach if unattended. His report was that of an epulis, an innocent looking, sessile tumor arising from the marginal gingival tissues. Many times these epuli are so casual in appearance that they are not examined microscopically for possible malignancy. The moral of this case is that all growths are potentially malignant until diagnosed otherwise. This patient, male, age fifty-seven, came to the hospital complaining of weakness, dyspnea on exertion and pain

noted two months later. At this time the ulcer covered the entire under surface of the tongue and a portion of the floor of the mouth on the right side. A mass also appeared in the upper left part of the neck fixed to the jaw. Following a low tracheotomy, there was a simultaneous upper neck dissection, removal of the tongue and floor of the mouth, and cauterization of the body of the mandible. Seven years later a new focus developed in the larynx. In spite of treatment, the process extended deep in the neck. Death ensued.

Extraction of teeth in the presence of cancer is of interest to the dentist. If teeth are extracted in the presence of undiagnosed cancer, valuable time will be lost in waiting for healing before any attempt is made to diagnose the lesion. This delay may allow a cancer to progress to such an extent that early death is certain. This mistake of extracting teeth in undiagnosed cancer is easily understood because many patients make their own diagnosis and present themselves for extraction. They demand extraction. These patients are displeased if the dentist refuses to extract the teeth to clear up an obscure gingival lesion, but should the tooth be removed and the diagnosis of cancer subsequently be made, these patients often profoundly blame the dentist. Therefore, extraction in undiagnosed cancer or chronic gingival ulceration is dangerous to both dentist and patient. Extraction allows invasion or direct extension, a metastatic process, into the central portion of the alveolar process by the tumor. Extractions also delay diagnosis of the lesion, thus permitting its spread during the waiting period for healing.

Adenocarcinoma of the stomach spreads by direct extension through the mesentery, limiting the movement of the intestines, causing stasis, obstruction, and peritonitis. Tumor cells become implanted on the peritoneal surface. It metastasizes to the regional lymph nodes and to the liver. Since the tumor is radioresistant and since radiation of the epigastrium damages the liver and pancreas with resulting systemic disturbance, radiation to gastric carcinoma is of limited value. Carcinoma of the prostate metastasizes to the skeleton more frequently than carcinoma of the breast The most common sites are the lumbar pelvis and sacral vertebrae. In 70 per cent of the cases of carcinoma of the prostate the disease has spread beyond operative fields before the diagnosis is made. In many cases the pelvic lymph nodes, bladder, and the liver are involved. When we consider carcinoma of the stomach we are dealing with the outstanding mortality producer

mouth cancer be eradicated only to recur at a later date and carry the patient into death. Surgery is resorted to when response to radon or radium therapy is negative. At this particular stage, stage III, conservation of malignant tissues and adjacent tissues contaminated is tossed overboard. Radical surgery is done with preservation of only important arteries, veins and nerves. Esthetic considerations are waived at the time. The only hope is for prolongation of life with comparatively comfortable activity as mentioned above.

However, care and good judgment must be observed or traumatism from block resection may cause a stimulation of the tumor cells, resulting in proliferation with subsequent metastasis to another region of the body by lymphatics, direct extension or blood stream. A secondary metastatic tumor may arise which could erode and gnaw its way into more vital organs or tissues and cause death of these patients. It is well to remember that one school of thought concerning biopsy is that taking the tissue from the biopsy may serve as a stimulant for the growth of the primary tumor. The same is true for the armamentarium of the oral surgeon and the orthopedic surgeon.

Cases reported and studied by Blair, Brown and Womack reveal that a carcinoma demonstrated in the nodes of a secondary metastatic tumor nearly always approximated that of the primary growth Metastases to the nodes appear long after apparent eradication of the primary growth and were found to be equally as malignant as the primary growth. Removal of these secondary growths requires a more extensive surgical resection. However, these cases are not hopeless, but the mortality rate is rather high — 21.5 per cent.

Blair, Brown and Womack reported a case of a male, forty-six years old, white, with a small tumor in the floor of his mouth three months prior to hospitalization. No treatment had been given. Regional lymph nodes were not swollen. No biopsy was taken because clinical experience proved this lesion to be malignant. Half of the tongue was excised. Four months later there was a left neck dissection. Two years later a right neck dissection was done because of recurrence on this side. This case may demonstrate that conservative surgery is not the cure-all for cancerous growths Metastasis was just a few steps ahead of the scalpel of the surgeon. Node metastasis, therefore, has been given a Group 3 grading.

Another case where surgery apparently stimulated metastases was that of a white male, fifty-six years old, admitted to the hospital. Three and one-half years prior a small ulcer was noted beneath the tip of the tongue. It was diagnosed as a benign tumor and excised locally. Recurrence accompanied with bleeding and pain was

if after mastectomy, it occurs as a recurring lesion in skin of the chest or upper arm. These nodules are usually pink or red, may vary from a millimeter to several centimeters; they may either elevate or infiltrate the overlying epidermis. If these nodules invade the epidermis, they may either produce ulcerating or fungating tumors. If the nodules combine in the subcutaneous tissue, they may produce a condition in the breast known as cancer en cuirasse.

Another unusual form of cancer metastasis to the skin produces a condition known as carcinoma eburne. In this type of metastasis the cancer cells propagate in the subepithelial spaces in a plane parallel with the epidermis.

In some cases the lesion of the cancer of the breast may have the appearance of dilated surface blood vessels. This lesion has been called carcinoma erysipelatodes telangiectaticum. One case has been reported where the skin of the lower extremities, thorax and abdomen became shiny, indurated and tense. On examination by microscope it was found that carcinoma cells were invading the subepidermal regions.

In all of these unusual conditions the authors consider the conditions metastatic manifestations of cancer of the breast.

Carcinoma of the lower lip is more common than that of the upper lip. It is usually of the squamous cell type. Cancers of the lip we find metastasize to the regional lymph nodes in a greater number of cases. Metastasis depends on the extent and activity of the lesion. It is worthy of repetition here and so it is done; in a report by Bernier, of 29 cases pertaining to carcinoma of the lip, there was metastasis in 26 cases to the regional lymph nodes, in 1 to the peribronchial nodes, 1 to the adrenal glands, 1 to the liver, spleen and lungs. Carcinoma of the lip does not metastasize as early as cancer of the tongue. Carcinoma of the lip does, if extensive enough, involve the bone of the mandible by direct extension or through the mental foramen, depending upon many factors, such as cell type, slow, or prompt and adequate treatment.

Malignant lesions in the corners of the mouth are subject to early metastasis, due to alternating compression and relaxation incident with mandibular movement, also from irritation caused by smoking and chewing tobacco, heat and pressure from the stem of a pipe, rough and jagged teeth. Thoma along with others believes carcinoma of the lower lip frequently causes metastasis to the mandible. He makes a report on 6 cases in which the total number had been treated at the primary site as a benign condition. A late diagnosis was made in all cases in which osseous destruction had occurred. Numerous times it has been ably demonstrated that

of the entire cancer group. About 25,000 persons die every year in the United States from cancer of the stomach.

Patients are prone to delay consulting a physician in regard to manifestations of this disease. It is estimated that the average person waits approximately six months after the initial symptoms before he seeks relief. A further delay of several months is usual before the diagnosis of cancer is established.

To make matters worse, it is also true that more than 50 per cent of all gastric cancers metastasize even before the initial symptoms appear. Add these two factors together – presymptom metastasis and unwarranted delay in reporting of symptoms – and it becomes obvious that the chances of making an early diagnosis are poor indeed, if we depend for diagnosis upon symptom manifestation rather than thoroughness and acuity in routine physical check-ups in the cancer-potential years.

Most authorities require *x*-ray examination of chest and spine before they will advise a patient suffering from cancer of the breast to submit to surgical treatment. Shackman and Harrison, however, point out that these *x*-rays may often be misleading and give an erroneous impression that the bony elements are not involved in the metastasis. In many autopsies performed by these men, they have found that there is a wide discrepancy between the *x*-ray pictures and the anatomical findings. They state that in some cases the bone marrow is completely filled with metastasic tumor tissue, yet the bony architecture is not altered and the *x*-rays show a normal picture The actual change in the bone is affected by the cells of the bone, the osteoblasts and osteoclasts. Because it is these cell changes that alter the bone, the radiologically visible bone changes will occur only after the marrow spaces have been filled. It is from these findings that Shackman and Harrison base their beliefs that normal radiographs cannot exclude the presence of bony metastases even in the most extensive forms.

The breast is the most frequent site for the primary lesion that metastasizes to the skin. It is a rare instance and infrequent occurrence when a neoplastic lesion metastasizes to the skin. It was found in a series of 500 cases of cancer originating in various sites of the body that only four-tenths of 1 per cent metastasize to the skin.

The neoplasms may invade the skin by direct extension, permeation or by way of an embolism through the lymphatics or through the blood stream. The lesion usually appears in the form of a subcutaneous nodule and appears in the advanced stages of carcinoma. In cancer of the breast it usually occurs in the skin of the breast, or

One of the most interesting features of some forms of metastatic growths is that they carry on the function of the organ from which they have originated. It was observed that metastases from osteogenic sarcoma may come from bone. A secondary growth from a malignant tumor of the thyroid gland at times produces thyrotoxic symptoms.

Another interesting feature about metastatic growths is that the histologic structure of a metastatic growth is sometimes more typical of the tumor from which it has arisen than is the primary lesion itself.

The evaluation and diagnosis of the disease in any patient is not complete until one has searched for the possible spread of the growth. These important points can never be overemphasized. The earlier the diagnosis the better the prognosis. Lesions, without the proper diagnosis, should never be treated. Men have been known to treat undiagnosed lesions by the use of *x*-ray, radium and silver nitrate. This is to be frowned upon for the fact that this practice may stimulate growth activity of the lesion with a greater possibility toward metastases.

When one is dealing with an adult with a swelling on the lip or inside the oral cavity with or without ulceration, which is not acutely inflamed, biopsy is the only sure diagnostic method. Intelligent therapy cannot be undertaken without it.

There are two errors commonly made. One is to treat an ulcer of the tongue or elsewhere as syphilis because the patient is shown to have syphilis when actually the lesion is an ulcerated epithelioma alone or an epithelioma which has developed into a syphilitic leukoplakia. The other common error is to treat an epithelioma of the gum as the alveolar manifestation of an osteomyelitis of the jaw following some dental infection. Every lesion secondary to a tooth socket infection which does not yield promptly to treatment should have a piece of tissue removed for microscopic examination.

Cancers of the pharynx and tonsillar regions are apt to be malignant both in regard to differentiation and because of the inaccessibility of their situation. The presence of lymph node metastases decreases the chance of ultimate survival to an enormous degree.

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carcinoma of the lip metastasizes unusually early, as compared to other parts of the body, even though the lesion is of a relatively low degree of malignancy.

It is a known fact that lesions of the tongue and the floor of the mouth metastasize much earlier than do those of the lip. This is due to the rich lymphatic and blood supply. Generally speaking, these lesions are more highly malignant than those which arise on the lips, cheeks and alveolar process. Cancerous lesions may begin in any part of the mouth. They may begin as a small fissure, a nodule or an ulcer. The nodule continues to grow and the tumor may be hard or soft. These lesions may ulcerate, bleed easily, or may be papillomatous or vegetating. They develop into larger ulcerative tumors which invade the sublingual glands and metastasize early. It would seem that the location, function, and sensory characteristics of the tongue would make early recognition of cancer in that organ almost certain in most instances. The organ itself is easily accessible for inspection and palpation; it is endowed with the sense of touch; it has a highly diversified mobile activity which produces many variable forms and exposes it to pressure from many directions. Nevertheless, there is a lapse of six months, in the average patient, between the first manifestation of lingual cancer and the appearance of the patient in a hospital for treatment.

When the regional lymph nodes are involved by metastases, the chances of cure are greatly reduced, but not necessarily excluded. Metastasis may occur early or late. Lymph nodes may be invaded without showing enlargement, whereas firm, hypertrophied glands are not necessarily already invaded.

Biopsy alone can establish the fact of invasion. The most important groups of lymph nodes to be checked, in lingual cancer, are the submaxillary, submental, and those further down the cervical region.

Malignant lesions of the maxilla and mandible appear to be rather rare. There are only a few cases brought to attention in the literature because of the fact that necropsy reports rarely include sections of the mandible and maxilla because of their disfigurement. Metastasis to the mandible and maxilla are of low grade type in nature. As a rule these do not metastasize until the soft tissues of the cheek, lips or floor of the mouth have become involved. Metastasis to the mandible and maxilla is a result either from direct extension from contiguous primary cancer or direct extension from adjacent metastatic cancer in a lymph node, or invasion along the dental canal or by blood borne metastasis from other primary sites.

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3. *Lupus Erythematosus.* – Distinguished by presenting areas of more inflammation. The lesions may have a white center with red borders which is never present in leukoplakia. Also, lupus erythematosus is usually located on the skin.
4. *Thrush.* — More common in infants. White plaques which are easily removed and the causative organism is demonstrable.
5. *Psoriasis.* – Rare on the mucous membrane. Consists of scaly patches which change from day to day and are located on other parts of the body.
6. *Apthous Ulcers* (canker sore). – Quite tender.
7. *Syphilitic Mucous Patches.* – Eroded patches present. Diagnose by taking a blood test.
8. *Cheilitis Exfoliativa.* — Usually confined to lower lip and consists of inflammation produced by exfoliation. Encrustations are present.
9. *Lichenification of the Mucosa.* — Consists of an exaggeration of the normal lines of the oral mucosa.
10. *Vincent's Infection.* – Differentiated by rapidity of onset, ease of which membrane may be removed, destructive character and the short time required for the healing of the individual lesion.
11. *Exfoliative Glossitis* –Characterized by a rapid progress and a desquamation of areas on the tongue.

The most important of the above listed will be discussed more fully later in this chapter.

In many respects the etiology of leukoplakia is still obscure or unknown. It is chiefly thought to be caused by a chronic inflammatory process which has some chronic source of irritation as its basis. Many theories, local and systemic, have been advanced to be the cause, however it is believed that it is rarely produced by any one certain cause but it is a manifestation of several processes.

The systemic causes may be listed as follows:

1. *Syphilis.* – This usually causes plaques on the tongue, as a result of interstitial glossitis, or within the oral commissure. The papillae disappear in whole or a part and the tongue has a smooth, scarred appearance. Leukoplakia develops upon these shiny areas.
2. *Gastro-intestinal Disturbances.* – It is thought that the mucous membrane is irritated in cases of chronic fermentative intoxications that occur along the alimentary tract.
3. *Individual Predisposing Factor.* – This may or may not be congenital. Some people have a more sensitive mucosa than others.

~ 8 ~

Leukoplakia and Lichen Planus

LEUKOPLAKIA

LEUKOPLAKIA is a term used to denote an intensely chronic, painless inflammation of the mucous membranes of the body, characterized by a development of irregular circumscribed, dry, hard, whitish patches of keratinized epithelium with a tendency toward malignancy.

Leukoplakia may be located on any mucous membrane. It has been reported as occurring on the bladder mucosa, pelvis of the kidney, endometrium of the uterus, vaginal mucosa, esophagus, and in the oral cavity, which is the primary concern of the dentist. It is thought to occur on the bladder and other organs as a result of chronic inflammation. Leukoplakia may occur on any part of the oral mucous membrane, red border of the lips and usually on the dorsal surface of the tongue. It is interesting to note that the thickness of the oral mucosa does not have any influence upon the location of the leukoplakia. The oral epithelium is thickest on the dorsum of the tongue and the subgingival margins and thinnest on the floor of the mouth and the inner surfaces of the lip.

Since 1 out of 100 persons shows leukoplakia it is essential that the dentist know how to diagnose the condition in order to save the suffering which would follow if it were allowed to proceed to malignancy. Leukoplakia is second to teeth as the etiology of mouth cancer. Kronfeld states that from 20 to 30 per cent of all the oral epitheliomas develop from areas of leukoplakia. It is necessary to correctly diagnose this condition in order to plan a treatment. Some of the conditions which resemble leukoplakia are as follows:

1. *Lichen Planus.* — This will cause the greatest difficulty in differentiating the two lesions. A discussion of lichen planus will follow later in this chapter.
2. *Fordyce's Disease.* — Granules or plaques have a yellowish hue, and a tendency to group in small lesions serves to distinguish this condition from leukoplakia.

The basic features of the histopathology of leukoplakia have been known since Nedophil, in 1876, and Leloir, in 1887, published their findings. As previously shown, the mucous membrane is basically similar to the skin except for the absence of epidermal appendages and a complete cornification. Thickening and keratinization occur in the squamous epithelium, with acanthosis or thickening of the prickle cell layer. Chronic inflammatory cells are located in the subepithelial layers.

Leukoplakia may be grouped into three or four stages or grades according to the condition of the lesion; they are as follows:

Stage 1: A reversible stage in which the mucosa will return to normal if the irritation is removed.

Stage 2: The lesion is no longer simple and reversible. Borders are not distinct. Definite acanthosis and hyperkeratosis are present.

Stage 3: Thickened, indurated, quite opaque and often granular lesion. This lesion is soon to become malignant and may be classified in another stage as a malignancy.

As for classification based on clinical characteristics as well as histological findings, McCarthy has given us one. He divides this condition, along with Prinz and Thoma, into four groups or grades.

Grade I is characterized by a well-defined, granular, slightly sensitive area of erythema which in a short time becomes slightly whitish gray. The microscopic picture presents "an inflammatory infiltration without definite epithelial proliferation".

Grade II appears to be a network of pearly white discolorations pasted on the mucosa. These patches are sharply outlined but are without palpable induration. Frequently the smooth surface is criss-crossed by irregular markings in such a manner as to form a modified trident of a fan on the cheek or form parquet-like subdivisions on the tongue. On palpation a peculiar roughness of the affected area will be detected. If there is extensive involvement at this stage the patient may complain of dryness of the mouth, and the tongue may be hindered in its movements if it too is involved. The microscopic picture presents a definite hyperkeratosis and acanthosis with a definite cellular infiltration in the subepithelial corium.

Grade III is definite and easily recognized by the layman. The milky white or pearly, indurated plaques are often raised and may be quite extensive in their coverage of the oral mucosa. Histologically the characteristics described in Grade II are accentuated and the classical picture of the disease is apparent.

In Grade IV leukoplakia the lesions are markedly indurated and leathery and present papillomatous formations. The mucosa is

4. *Hormone Disturbances.* – This is thought to play a role in the cause of leukoplakia especially in women in the menopause when a deficiency in the sex hormone is present.
5. *Neurasthenia.*
6. *Gouty Diathesis.*
7. *Anemia.* – Especially in women.

The local causes of leukoplakia are as follows:

1. Tobacco. – Forty-five years ago Butlin stressed the cause by tobacco smoking and even today it is highly regarded as one of the chief local causes. The lesion occurs at the site on the tongue or buccal mucosa that is struck by the hot stream of smoke. Tar and oily products of combustion along with sharp juices and chewing produce the source of irritation. According to Lyman tobacco contains a carcinogenic compound, benzopyrene, or the presence of products of arsenic used to spray tobacco during the cultivation period serve as the irritants. Also he states that a more recent etiology was due to degenerative changes in the mucosa which are aggravated by the use of tobacco. Cigarette smoking is considered the least dangerous while pipe smoking causes the greatest amount of danger. It has been noted that in localities where women smoke as frequently as men the sex incident of leukoplakia became equal instead of being predominantly in men as previously stated.
2. Decayed and sharp ragged teeth
3. Trauma produced by nervous biting habits.
4. Electric currents produced by different metals within the oral cavity.
5. Faulty dental restorations.
6. Allergy to denture base materials
7. Avitaminosis — Vitamin A and B deficiency.
8. Idiopathic.
9. Dyes in lipsticks and cosmetics.
10. Strong proprietary mouth washes
11. Hot and highly seasoned foods
12. Beverages high in alcoholic content.
13. Occupational – Coffee and tea testers, carpenters, tack spitters, and telephone service men who contact metals and current.
14. Food allergies.
15. Chemical and bacterial irritants.
16. Oriental betel-nut chewers.

rapid appearing covering membrane, slightly inflammatory surrounding areola, rapid onset, usually moist character, occurrence in the commissure as a split-pea-sized lesion with a superimposed moist grayish white necrotic covering and the usually concomitant generalized skin eruption, with an angina and generalized enlargement of the lymphatic glands, will establish the diagnosis.

The tertiary lesions of syphilis present the most difficulty in a differential diagnosis between syphilis and leukoplakia. The sclerosing glossitis of the tongue, and white depressed color are due to scar formation, with the resultant fibrous replacement which causes the production of minute bands from which the mucous membrane disappears. In general, the absence of scars and of sclerotic and infiltrating areas differentiate leukoplakia from tertiary syphilis.

Exfoliative glossitis or geographic tongue with desquamating areas of the tongue resembles leukoplakia at times, but there is a great rapidity in progress of the disease, which is different from the chronic course of leukoplakia

Although Fordyce's disease has more points of dissimilarity than the above conditions, it should be considered on account of its frequency.

Fordyce's disease is a developmental defect of the sebaceous glands of the oral mucosa. This developmental deficiency can be recognized by the yellowish white nodules which on palpation, instead of being rough, are smooth, rounded or oval bodies. Although not symmetrical in distribution, they are, as a rule, bilateral and the areas of predilection are on the upper lip and in the interdental area of the buccal mucosa.

Acute ulcerative conditions, such as Vincent's infection, aphthous stomatitis and thrush also present lesions of grayish white. They are all differentiated from leukoplakia by the hyperesthesia associated with them, the pain which they usually produce, and rapidity of their onset, the short time consumed in the complete evolution and healing of individual lesions and the ease in which the grayish white necrotic membrane can be removed.

Lupus erythematosus may be differentiated from leukoplakia by the inflammatory nature of the lesions. The center of the lesion may be white, but the border is distinctly reddened, a condition never seen in leukoplakia.

Cheilitis exfoliativa is an inflammation associated with exfoliation, usually confined to the lower lip. The encrustation can be removed with little difficulty except where it fades into the normal lip tissue.

covered by layers of keratinized epithelium which are often coated with a heavy fur. Warty outgrowths are present which often form rather large nodules. With the downgrowth of epithelium, fissures form, thus causing localized induration.

This stage is often called neoplastic leukoplakia because it has neoplastic potentialities. In such cases speech may be handicapped because of the impediment of the tongue. Spontaneous desquamation and ulceration sometimes occur in the affected area.

Leukoplakia is largely a disease of males which is more apt to occur in the fifth and sixth decades of life, and is rarely ever seen in the pure-blooded Negro.

The diagnosis of leukoplakia is based and bound on the clinical picture, clinical history and biopsy in questionable cases. A well-established case of leukoplakia offers little or no difficulty in diagnosis to the trained observer. Before an examination of the oral cavity is made, the age and sex of the patient should be taken into consideration. Since the disease can be found hidden anywhere within the oral cavity, a careful search should be made for the presence of lesions.

The mere presence of a white or grayish-white patch in the oral cavity should not be designated offhand as leukoplakia. While the typical patch of leukoplakia usually presents no diagnostic difficulty, there are other conditions which may simulate it. At times, even histologic examination will not be sufficient for definite diagnosis of the lesion in question.

Some diseases to be differentiated are as follows:

Lichen planus offers the greatest difficulties in differential diagnosis. This disease, however, usually affects the skin and the oral mucosa simultaneously. It occurs on the body especially at the wrists, on the forearms, on the lower extremities and, at times, over the entire body The lesions on the skin are a reddish or violet hued papular eruption. The papules tend to be polygonal and to follow the lines of skin trauma, and produce a marked pruritis. On the oral mucosa there appear bilateral white striae, presenting here and there small nodular swellings in their course. At times, lichen planus of the oral mucosa occurs alone, without skin manifestations, in which case the differential diagnosis, of course, becomes much more difficult.

Syphilis produces many types of lesions in the mouth, and in no case in which mucous membrane lesions are present should the possibility of syphilis be overlooked. Among the secondary syphilitic lesions, the so-called mucous patches may be mistaken for leukoplakia. Hollander states that their depressed character, very fine

rapid appearing covering membrane, slightly inflammatory surrounding areola, rapid onset, usually moist character, occurrence in the commissure as a split-pea-sized lesion with a superimposed moist grayish white necrotic covering and the usually concomitant generalized skin eruption, with an angina and generalized enlargement of the lymphatic glands, will establish the diagnosis.

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Cheilitis exfoliativa is an inflammation associated with exfoliation, usually confined to the lower lip. The encrustation can be removed with little difficulty except where it fades into the normal lip tissue.

The presence of marked inflammatory changes and the formation of crusts differentiate it from leukoplakia.

Psoriasis, which involves the mucous membrane only occasionally, is characterized by whitish lesions with scales that are easily removed. The patches have a tendency to change from day to day, and the patient has psoriatic lesions on other portions of the body, characteristically on the points of the elbows and knees, on the scalp and over the sacral region.

Leukoplakia is a disease of a decidedly chronic character. The course of the disease depends on the cause and on preventive and local treatment. In some cases the removal of the irritating factor favors the disappearance of the lesion. The conditions comprising Grade I and Grade II have a tendency to disappear after removal of the causative factor. Grades III and IV have a less favorable prognosis.

There is no question that leukoplakia is a forerunner of a malignant process. It corresponds in pathologic changes to the keratotic lesion of the skin. The subsequent malignant growth is always of the squamous cell type, but the malignancy tends to be of low grade, making the prognosis more favorable. The ulcerative, indurated type of leukoplakia develops into a growth with the highest degree of malignancy.

The incidence of cancer developing in the lesion is quite great. Sturgis and Lund state that in their reported series of 298 patients who had leukoplakia with no malignancy before or at entry, 12 per cent developed cancer later. They state that according to their calculations patients with leukoplakia or keratosis of the lip develop buccal cancer at least 12 times more frequently than chance alone would predict.

The treatment of leukoplakia depends on the duration, extent and the stage. Once leukoplakia has been established it is very difficult to remove. The primary factors in the treatment consist of a thorough prophylaxis rendering the mouth as clean as possible The irritating factor, if known, should be eliminated, whether it is systemic or local, before an attempt is made to clear up the leukoplakia. The patient may be placed on a milk of magnesia mouth wash after each meal and before going to bed The patient should also be placed on a spice-free diet If no results are obtained after fourteen days then it may be advisable to destroy the lesion, under local procaine anesthesia, including a margin of healthy mucosa. It may be wise to destroy only a portion of the lesion at a sitting if it is extensive. Vaughn has reported cases of leukoplakia regression when it is covered with a denture. As

previously stated, simple elimination of the etiology may be all that is necessary to treat this condition when it is in Stage I. In the past leukoplakia lesions have been massaged several times daily with glycerine plus a flavoring and coloring agent. Good results have been reported using the above described method. If fissures or ulcers are present it is wise to excise with electrocautery, going into healthy tissue to avoid recurrence.

Roentgen rays and radium are of little or no value in the treatment of leukoplakia and often are contraindicated. Silver nitrate or other irritants should not be used on a precancerous lesion because they might introduce the necessary irritation to produce malignancy.

The prognosis of leukoplakia is favorable unless ulcerations and fissures are present. The greatest percentage of leukoplakia does not develop into a cancer, especially if the irritating factor is removed. Many people have leukoplakia for years without any subjective symptoms. However, if these lesions do not clear up within a month under the proper therapy they should be very seriously considered, and referred to a competent cancer authority. If the patient has passed sixty years of age, especially with extensive involvement it, for safety, should be considered cancerous and kept under constant observation.

A few cases of leukoplakia worthy of mention are as follows:

A case of early malignancy from leukoplakia of the lip was reported by Winn of the Army Medical Corps. This case was a white male, aged twenty-five. For four months he had a thickening on the lower lip, predominantly on the mucous portion, which gradually increased in extent. The lesion was grossly a slightly elevated growth about 4 mm. in diameter mounted on an elliptical portion of skin and mucosa. The photomicrograph showed normal epidermis and the remainder enormously thickened showing all the characteristics of leukoplakia, namely hyperkeratosis of the horny layer and hypertrophy of the malpighian layer. There was chronic inflammation in the underlying corium. The granular layer was shown to be more prominent than normal. The basal layer showed dyskeratosis or premature and disarranged maturation of the cells.

Another case was a white male, aged fifty. The lesion existed on the right cheek in a position to be bitten. It appeared pinkish white, slightly raised, and of elastic consistency. It was not painful. Microscopically there was hyperplasia of the epithelium and broad rete pegs in one particular area. There was more than normal keratinized material over the surface. Cells of the malpighian layer were frequently hydropic. In this latter case the decision was nonmalignant. Biopsy relieved suspicions of the area.

A case of leukoplakia reported in Australia was a female, aged seventy-eight. She was seen in May of 1947, complaining of pain in the lower jaw of eight months' duration. She thought the pain was from pressure of the lower denture. The old dentures had been adjusted and then new ones made. This patient had thick patches of leukoplakia on the gums and molar regions, the condition being bilateral. The right side extended onto the cheek with a raw red ulcerated area in which induration was revealed by palpation. The provisional diagnosis of leukoplakia with early carcinomatous changes was made. A biopsy was taken and she was put on sedatives, mouth-washes, and advised not to wear the lower denture. The tissue taken from the left side showed a typical picture of leukoplakia. The right side biopsy of the indurated area showed epithelial proliferation and many cells showed mitotic figures. In parts the squamous cells were seen invading the connective tissue. This confirmed the diagnosis of early carcinoma. The treatment used was implantation of radon seeds in the carcinomatous area and superficial diathermy to the leukoplakic patches. In August of the same year her condition was satisfactory

A very serious case was that of a white male, aged fifty-eight. He presented papillary leukoplakia on the dorsum of the tongue. This lesion had been present for nine years On palpation the lesion proved to be hard, leathery, and hornified. There was induration but no tenderness, nor was there pain. Lymph nodes were not palpable. Wassermann test showed four plus. The diagnosis was. leukoplakia of papillomatous or verrucose variety and syphilis. Family history was negative and he denied exposure to syphilis. He was unmarried, traveled, and lived with a maiden sister. The patient smoked a pipe and cigars excessively. He was advised to discontinue smoking and surgical removal was recommended Routine treatment for syphilis was given. He was seen once two weeks later and not seen again for four years. This time tests for syphilis were negative. He had quit smoking. Biopsy was made and confirmed the clinical diagnosis of carcinoma, squamous cell Grade II. Now the lesion was too large for primary treatment by conservative measures Preliminary radiation was given to the neck and the entire tongue removed by cautery glossectomy. As to the outcome of this case, in the succeeding years there was no recurrence and the patient has successfully engaged in business This is a case where carcinoma developed from papillary leukoplakia of the tongue and might have been prevented by early treatment.

LICHEN PLANUS

Lichen planus is a disease both of the skin and mucous membrane, especially of the mouth, characterized by grayish-white patches on the tongue or buccal mucosa. Lichen planus was described as early as 1869 by Erasmus Wilson and was known as ruber planus.

There are two forms of lichen planus that may occur in the oral cavity. One form consists of pearly annular lesions forming within themselves fine, or wide meshed geometric patterns of circinate, or lace-like, appearance. The other form consists of nodular patches resembling cautery by use of silver nitrate.

The etiology is unknown. Jacob and Helmbald isolated from 28 cases of lichen planus a gram-negative anerobic bacillus, and were able to reproduce the disease in human beings. Other researchers believe that the disease is correlated with nervous exhaustion from overwork, grief, anxiety, and other forms of mental strain.

Histopathologically, the lesion involves both the epithelium and the papillary layers of the corium. The stratum granulosum may appear condensed in some cases while it is thickened in others. The basal cell layers of the stratum germinativum may be disarranged, appearing separated from each other and irregularly placed. There is no definite junction between the epithelium and the corium. There is evidence of mononuclear cell infiltration and edema in the corium Perivascular infiltration of polymorphonuclear leucocytes may be present but there is no evidence of plasma cells. The infiltration does not involve deeper layers of the corium and it is very well defined. The horny layer may grow to be a tremendous size with horny pearls and abnormal keratinization present.

The lesions of lichen planus manifest themselves in the acute form as small, flat, shiny, bright, red, umbilicated papules, which are at first discrete, but which may combine to form patches. In the chronic form they coalesce to form irregular scaly patches, becoming grayish-white with criss-crossed white streaks on the gingivae and buccal mucosa. Usually, however, the eruptions are limited to certain regions, especially the flexor sides of the arms and legs. The entire body may be covered, or the mucous membrane of the genitals only may be affected. When these lesions coalesce they do not regain their distinct outline and desquamation, ulceration, erosion and scarring does not occur. The remaining life of the lichen planus after coalescence has occurred is in a rhomboidal patch. These lesions may be located on the soft and hard palate and tongue as well as the buccal mucosa and gingivae,

which may be subjected to irritation. Oral lesions may be present with or without skin lesions but when plaques of the chronic stage form there usually appear the skin lesions. Mouth lesions may frequently occur around crowns, bridges, third molars or anywhere the mucosa may be irritated. In diagnosis, before visible signs are present the patient may complain of hypersensitivity to warm or spicy foods.

Lichen planus occurs most commonly during adult life, between thirty and sixty years of age. It is rare in childhood and old age. It may run a course of several months to four years with frequent relapses occurring, and before any signs of oral lesions appear the patient may complain of sensitive mucosa, especially to the abovementioned warm and spicy foods. The tongue may have a furrowed coated feeling. After the chronic stage develops the entire mouth may become uncomfortable and develop an itchy sensation. The itchy sensation may be so great that it causes a loss of sleep, hence producing a neurasthenia which is the only symptom of systemic association with lichen planus. Others that might have been included here would be skin eruptions which usually develop on the flexor surfaces of the wrists, arms and thighs. Seldom do these lesions appear on the scalp, face, palms or soles but sometimes they may be present on the back of the hands and fingers.

Even though lichen planus is difficult to cure and consists of a chronic course, the prognosis is usually good. As in most diseases, the treatment is varied but one of the best methods is by the administration of heavy metals such as bismuth, arsenic and mercury. The neurasthenia should be regulated with plenty of fresh air, wholesome food, quinine, iron, small doses of cod liver oil or a tonic, and the patient should be completely relieved of any mental strains. The lesion responds almost immediately to roentgen ray therapy but it often recurs unless completely destroyed. Destructive measures are not indicated.

Heavy doses of vitamin B complex and estrogens and androgens have given desirable results in some oral cases. Ziskin reported favorable results with the use of topical applications of an estrogenic ointment (estradiol benzoate) applied as follows: shellac base plate trays were made to overlap the teeth and gingivae, then filled with the estrogen ointment and carried to place and allowed to remain in contact with the tissues for forty-five minutes. This method of application was repeated once each week for twenty-five consecutive weeks, and was augmented by home treatment by having the patient apply the ointment on all affected parts at least once a day, usually before retiring. Ziskin also prescribed vitamin

A, 50,000 international units by mouth daily and 100,000 inter tional units intra-muscularly once a week.

An illustrative case of lichen planus and desquamative gingiv is the following: A white woman, aged thirty-eight, complained a feeling of stiffness, burning, and tenderness of the cheeks, floor the mouth, and limitation of tongue movement because of soreness. Hot foods were also a source of irritation. The pati first noticed inflamed areas on the gingivae above both centr and the left lateral incisor, about three months prior to her f visit to the clinic. Lesions presenting clinical characteristics lichen planus were observed on the cheeks, floor of the mouth a palate at this examination. She had been using various mou washes which were discontinued at that time, and she was put a regimen of vitamin B complex therapy consisting of three capsu daily for forty-five days. Mild salt solution was used during t period as a mouthwash. This therapy produced no symptoma improvement. On a subsequent visit, it was discovered that ma new areas of desquamation had appeared. The lichen planus lesi remained unchanged. The patient continued to complain of p and sensitivity especially to hot foods.

Observed were bright red areas on the upper labial and buc gingivae over the right and left central and lateral incisors a cuspids; the upper left first bicuspid; upper right first molar; a on the lower labial and buccal gingivae around the left bicusp and molars; and lower right bicuspids. Lichen planus-like lesi were also observed which covered the inner surfaces of the chee mucobuccal folds, hard and soft palate, lateral borders of tongue and floor of the mouth, and mucous membrane of the li

As for microscopic findings, the whole papilla was atrophic. T epithelial peg pattern had disappeared. In the alveolar gingiva keratin was somewhat reduced in thickness, but a layer of pa keratosis about two cells deep was seen under it. In the arec gingiva, a well-defined keratin layer was seen extending onto the mucous membranes. Under this keratin layer a few granul cells were seen. The epithelium was much reduced in thickn throughout, while in some areas it was exceedingly thin. Int and intra-cellular edema was seen throughout. A dense zone inflammatory exudate composed chiefly of round cells, was se in the papillary layer throughout the entire section. The ede in this section was quite marked and in some places, the epitheli could be seen stripping off from the corium. Inflammatory exud and edema extended deep into the connective tissue. The ba cell layer had also undergone atrophic degeneration. In the coriu

the vascularity was markedly increased. The cheek tissue appeared to follow quite closely the description already given for the gingiva. The basal cell layer here did not present the same degree of destruction although some necrosis was present.

The treatment in this case consisted of the topical application of an estrogenic ointment (estradiol benzoate). This after a period of four months seemed to clear up the desquamated tissue but did not affect the lichen planus lesions. Vitamin A therapy was begun orally and intramuscularly and as long as this therapy was continued the lichen planus seemed to clear up, but when the therapy was removed the lesions recurred.

It is essential that the dentist be able to differentiate the lesions of leukoplakia and lichen planus especially, therefore the chief characteristics of each will be reviewed.

Lichen planus does not become as thick and whitish as does leukoplakia but is likely to be a delicate bluish-white. Lichen planus lesions tend to arrange themselves into networks instead of plaques. Usually a body examination will show the appearance of lichen planus on certain areas of the skin.

Since the dentist has usually the most frequent look at the oral cavity, it is essential that he be familiar with the various lesions of the oral mucosa. In leukoplakia and lichen planus he is dealing with two similar chronic conditions of the oral mucosa, one of the lesions being precancerous and the other not; but both are rather difficult to treat and may recur unless properly destroyed. As previously stated, leukoplakia is not successfully treated with *x*-ray or radium while lichen planus responds rather well to this treatment. Securing the combined efforts of the pathologist, physycian, dentist and cooperation from the patient, the prognosis of both conditions is good especially when they are diagnosed early. Thus, it behooves all of us to strive to spend a bit more time to correctly diagnose these conditions in order that we may intelligently treat them, thus relieving the patient of probable cancer and much worry and suffering.

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network of capillaries. Motor fibers of the sympathetic and parasympathetic nervous systems pass through the basement membrane and terminate between the secretory cells. Sensory innervation is furnished by the trigeminal nerve.

The parotid is the largest of the paired salivary glands proper. It is located on the side of the face within the posterior part of the cheek, below and in front of the external ear. It occupies a space bounded by the sternocleidomastoid, the mastoid process of the temporal bone and the ramus of the mandible. The gland envelopes part of the posterior border of the ramus, a portion extending around on the medial surface of the ramus, and another portion extending laterally and anteriorly over parts of the masseter muscle. Important structures within the gland include the external carotid artery and its branches, the posterior auricular artery first, and then the terminal branches; the internal maxillary and the superficial temporal arteries. The posterior facial vein is formed in the gland by the uniting of the internal maxillary and superficial temporal veins. In the lower part of the gland, the posterior facial vein splits into an anterior and posterior division, the posterior division uniting in the gland with the posterior auricular to form the external jugular vein. Nerves found in the gland substance are the facial nerve, branches of the great auricular, and the auriculotemporal nerve. Stensen's duct, which begins by numerous branches from the anterior portion of the gland passes forward externally to the masseter muscle, then at the anterior border turns inward passing through the buccal fat and the buccinator muscle, then forward between this muscle and oral mucosa to its orifice, which opens on the oral surface of the cheek opposite the upper second molar tooth. The lymphatics pass through two or three nodes in the substance of and on the surface of the gland to the superficial and deep cervical lymph nodes. The gland receives its blood from the external carotid and its branches in approximation. It is drained by the external jugular through tributaries, and is innervated by the facial, auriculotemporal, great auricular and the sympathetic plexus on the external carotid artery.

The submaxillary gland is about the size of a walnut, and most of it is located in the submaxillary triangle. The gland is separated posteriorly from the parotid gland by the stylomandibular ligament. It is in relation with the submaxillary fossa of the inner surface of the mandible and lies mostly below the mylohyoid muscle. A lobe of the gland, however, passes above the mylohyoid, thus increasing the surgical problem of removing the gland. Wharton's duct drains the gland, opening into the oral cavity by a small orifice lateral to

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Malignant Tumors of the Salivary Glands

SALIVARY glands in man are exocrine and their primary function is to receive materials from the circulatory fluids of the body, transform them and secrete them into the oral cavity. These glands may be divided into those of major secretion or the salivary glands proper, and those of minor secretion. In the first group belong the parotid, submaxillary, and sublingual glands; buccal glands, glossopalatine glands, palatine glands, and glands of the tongue, which include the gland of Blandin-Nuhn and the glands of von Ebner. It is possible that these glands also have an excretory function. They may be further classified as to their predominant type of secretion into albuminous (or serous), mucous and mixed glands. The parotid gland is a serous gland, the cells of which liberate the enzyme ptyalin. Pure mucous glands are found among those of the tongue, the palatine and glossopalatine glands. The sublingual and submaxillary glands are both mixed glands, the sublingual containing predominantly mucous cells, and the submaxillary predominantly serous cells

Besides the serous and mucous cells mentioned, the ducts leading from the alveoli and merging to form larger ducts are lined with epithelial cells which change in type as they progress to the oral cavity. The alveoli which are composed of serous and/or mucous cells are surrounded by connective tissue stroma which often contains fat cells. Groups of alveoli form lobules which are likewise covered with a heavier sheath of connective tissue.

A lobe is a larger unit composed of a group of lobules. The lobe is also enclosed in connective tissue which mingles with the surrounding fascia. There is no muscle tissue present in the salivary glands, but secretion is effected by means of myoepithelial (basket) cells. These cells surround the ducts and alveoli in a spider-like manner and contract under proper stimulation Although these cells function to support the glandular elements, they are believed to be of epithelial origin

The blood supply to the glands is effected by intimate contact with the basement membrane of the alveoli and ducts through a

mesenchymal and epithelial, and (*c*) wholly or chiefly epithelial. Some of those of the mesenchymal school think that these tumors originate from connective tissue, while others believe the vascular endothelium in the connective tissue of the salivary glands gives origin. Some of those who adhere to the idea of mesenchymal and epithelial origin reason that since the tumors may have epithelial pearls, glandular epithelium, cartilage, or a fibromyxomatous structure, it might be possible that they originate from remnants of the embryonal, branchial anlage. Ahlbom belongs to the epithelial school of thought. He believes that some of the tumors are of glandular origin, from the adult execretory ducts and acini of the salivary glands; whereas others may result from detached embryonal epithelial anlage. The stroma he believes to be the result of secretion by the epithelial cells or the result of metaplasia of these cells. He admits that the question of the histogenesis of salivary gland tumors is not clear, and that it is unlikely that it will be solved by any one of the various theories as to origin. During the early part of this century, the endothelial theory seemed to have quite a few proponents. In 1904, Wood made a report on 59 tumors from the salivary glands, lips and pharynx. Of these 59, he considered 54 to be mixed tumors of endothelial origin. He argued against the epithelial origin, reasoning that if these mixed tumors were carcinomas, there should be some connection traceable between the tumor and the glandular structures of the salivary glands, whereas in the majority of the cases, the tumors were enclosed in a capsule. Another argument he used was the fact that these tumors might be present for many years without involving surrounding structures. Still another argument he presented was the fact that true carcinomas had been found in the salivary glands which ran a typical carcinomatous course, such as early metastasis of regional lymph nodes and invasion of surrounding tissue. In 1912, Wilson and Willis reported on a study of 56 mixed tumors of the parotid and submaxillary glands, 50 of which were located in the parotid. Their idea of the origin of these tumors was mesoderm. They believed that during the fourth week in the development of the embryo, the bud of the salivary gland, in pushing its way through the little differentiated mesoderm, displaced some of this tissue, which was later stimulated to proliferation. In 1918, Fraser, after a study of neoplasms which he produced in the submaxillary gland of dogs, contended that mixed tumors arise from the ducts of adult glands. Another of his contentions in support of the epithelial origin was that cartilage and myxomatous tissue found in these tumors had developed from the epithelium of the parenchymatous

the lingual frenum on the plica sublingualis. The lingual nerve is in close apposition with the gland, passing over Wharton's duct near the posterior border of the sublingual gland. The chorda tympani and lingual furnish the nerve supply through the submaxillary ganglion. The external maxillary and lingual arteries furnish blood, while drainage is into the anterior facial vein.

The sublingual gland is the smallest of the three salivary glands proper, its size being approximately that of an almond. It is in relation with the sublingual fossa of the internal surface of the body of the mandible. The lingual nerve and Wharton's duct separate the gland medially from the genioglossus muscle. It lies above the mylohyoideus and anterior to the submaxillary gland. The drainage of the sublingual gland is not consistent. The small ducts of Rivinus may empty into Wharton's duct or into the mouth directly (or the plica sublingualis). Several ducts may unite to form the larger duct of Bartholin which opens into Wharton's duct. Blood is furnished by the sublingual and submental arteries. Innervation is similar to that of the submaxillary gland.

A variety of tumors are reported to be found in the salivary glands. Adenomas, lipomas, hemangiomas, lymphangiomas, adenocarcinomas, carcinomas, fibrosarcomas, and mixed tumors have all been reported, but by far the most common and controversial are the mixed tumors of the salivary glands. Mead reports that these mixed-cell tumors are 12 times as common in the parotid gland as in the submaxillary, and that they are hardly ever found in the sublingual gland. Other sites for these tumors are the lacrimal glands, neck, orbit, palate, buccal mucosa and lips. Although most of these mixed tumors are benign, it has been reported that 1 in every 1,607 patients examined in the Mayo Clinic from 1915 to 1919 had malignant mixed tumors of the parotid gland In dealing with these tumors, we are dealing with a group in which there is no general agreement on terminology, and about which there is much dispute as to origin. Dockerty and Mayo have suggested that the term "complicated" should have been used to designate these mixed tumors of the salivary glands. To support this contention of complexity, it might be mentioned that a paradox seems to exist in that malignant neoplasms of the parotid have benign qualities inasmuch as they metastasize to distant organs only rarely, whereas benign tumors recur frequently after incomplete excision, which would denote a malignant quality.

Ahlbom presents one of the most searching works on the origin of tumors of the salivary glands. He mentions three general schools of thought about their origin, namely: (*a*) mesenchymal, (*b*)

though there is some disagreement as to some of the details, there have been proponents of each of the theories throughout the period of research on these tumors. It has rather been the intent to present some of the theories with evidence to support them and to give the general trend of thought as to theories.

Although much of the earlier literature deals with the origin of these tumors in an effort to arrive possibly at the etiology, some of the later literature is concerned more with correlating histological findings of these tumors with the clinical findings so as to make a more accurate prognosis. McFarland, in a study of 300 mixed tumors of the salivary glands, failed to find any correlation between the clinical behavior of the tumors and the histopathological findings. He reported cases in which the histopathology suggested sarcoma but clinically, the tumor was of the mixed variety. He mentioned several cases which were carcinomatous under the microscope, but clinically, not so. However, he did find some cases which suggested carcinoma and clinically, he was convinced they were such. He reported recurrence in over 23 per cent of the tumors he investigated. He reported cases of tumors which had been diagnosed as carcinoma or sarcoma, but failed to recur after excision. He is of the opinion that in many cases in the literature, a surgeon was given credit for skillfully and completely removing a malignant tumor of the salivary glands since it never recurred; but, actually, no malignant lesion was ever present. Patey also did some research along these same lines and although he did some correlation between the histological and clinical findings, the correlation was incomplete. He found that recurrences might be divided clinically into "encapsulated" and "infiltrative" types, and that histologically, a capsule was present in the encapsulated, whereas the surrounding tissues showed infiltration in the infiltrative type. The prognosis of the encapsulated type was found to be similar to that of the original tumor, while the prognosis was worse, as would be expected, in the infiltrative type. He failed to show, however, any change, histologically, when the tumors recurred. In 1935, Ahlbom stated that, "There is no uniform opinion in the literature as to which mucous- and salivary-gland tumors are histologically benign, and which malignant". He classifies these tumors as either malignant, semi-malignant, or benign. His criteria for malignancy are metastasis, infiltration, and destruction without encapsulation. He and his assistant, Reuterwall, classified 214 salivary gland tumors histologically into 80 cases of benign tumors, 37 cases of semi-malignant tumors, and 97 cases of malignant tumors. (The relatively large number of malignant tumors is no index of the

cells of the tumor, a claim which was apparently radical at that time. Some few years later, New expressed his inclination toward believing that these tumors develop from embryonic tissue. He argued against Fraser's concept of origin from ducts of adult glands in almost the same words that Wood used against the epithelial theory, namely, that the tumor is encapsulated and not connected with the gland. In 1930, Patey presented arguments for the epithelial origin of mixed tumors of the salivary glands. He presented microscopic slides from his studies which showed that different gradations of tumors were present, from a mass of undifferentiated cells to a well-developed glandular tumor. Not only did he find these gradations in different tumors, but often in the same tumor. In one slide, he showed the cells tending to differentiate toward squamous epithelium. He mentioned that the epithelial theory had not been too well-accepted in the past because a suitable explanation had not been found for the presence of cartilage in these tumors. He reasoned that this might not be true cartilage, after all. He presented slides of tumors removed from skin of the chest and of the thumb in which there were areas that resembled the so-called cartilage of the mixed-cell tumors of the salivary glands. He pointed out that these last two tumors were obviously of epithelial origin, yet they contained this cartilage-appearing material. About this same time, Brunschwig asserted his belief in the epithelial origin by stating, "The carcinomatous nature of malignant mixed tumors has become generally recognized". More recently, MacFee substantiates the epithelial origin of these tumors by stating that it is probable that if a group of cells are pinched off from the solid terminal branches of the developing budding anlage of the salivary glands, they may be later activated to bud, which, when accompanied by the development of a connective tissue capsule, might form either a benign or malignant tumor, depending on whether the development of the capsule keeps pace with the proliferation of the epithelium or not. More recently still, Halpert and Tool offer an explanation of how connective tissue elements may be found in these tumors and yet be of epithelial origin. They believe that there is a separation of cells from the ectoderm before it has actually acquired the characteristics of either ectoderm or mesoderm, and subsequently, it might differentiate into either or both of these tissues

It has not been intentionally inferred in the foregoing paragraph that there was a chronological transition from one theory of origin of these tumors to another, for such is not the case. While true that most authors today adhere to the theory of epithelial origin, even

involvement, shows that these tumors are rather atypical and belong in a class by themselves.

Recently, Stewart, Foote and Becker describe muco-epidermoid tumors of the salivary glands which may be either benign or malignant. The malignant tumors are characterized by their highly fatal character and their tendency to metastasize to cervical lymph nodes when metastasis is present. It is interesting to note that in the metastasis there is a sharp reflection of the primary tumor. It is their belief that these tumors originate from ducts of the salivary glands. Bernier surveyed some material at the Army Institute of Pathology in Washington, and was able to demonstrate 1 case of malignant and 1 case of benign muco-epidermoid tumors. Godwin and Colvin describe two cases of benign muco-epidermoid tumors. In the first case, the lesion did not extend into the parenchyma of the parotid, but after removal, there was recurrence of it. In the second case, the tumor did extend into the parotid, but had not recurred after four years.

Diagnosis of malignant lesions of the salivary glands is obviously very difficult, in view of their complexity and atypical behavior. The malignant tumors must be distinguished from benign and semi-malignant ones, since the treatment of the latter two, which is essentially the same, is different from that of the malignant ones. Age may be of some help in the diagnosis of malignant growths due to the fact that certain types would be expected in certain age groups. Rate of growth may aid in diagnosis, but it has been found that these neoplasms do not always grow at a rapid rate. There are relatively few symptoms in these lesions, none of which are definitely pathognomonic. Without any apparent reason, a small swelling or nodule appears. Its rate of growth is usually slow but may be fast. As in both benign and malignant, there may be a history of a tumor having been previously removed from the site, however, if the history shows that the original tumor was removed without rupturing the capsule, even though, histologically, it was benign, the recurrent tumor should be suspected as malignant. Pain is not usually present but may be, especially in later stages or when secondary infection has set in. Encroachment on sensory nerves may cause pain or paralysis. Shooting or stabbing pain may be referred to the jaw, ear or side of the face. Where the growth is large, opening the mouth might elicit pain by compression. Facial paralysis might be present in advanced cases, especially if the tumor is of the parotid region. Careful palpation is very helpful in making a diagnosis. A connective tissue capsule might be detected in a benign tumor, which one would expect

incidence since his clinic treated particularly malignant cases.) Of the 97 malignant tumors of the salivary glands, 34 were classified histologically as mixed tumors (which were further broken down into fibro-epithelioma, fibromyxo-epithelioma, fibromyxo-chondro-epithelioma, and fibromyxo-sarcoma), 29 as being predominantly basal-cell cancer type, 11 as being slightly differentiated or undifferentiated epithelial type, 10 as being predominantly papillary cystic, 7 of the adenocarcinoma type, 4 of predominantly squamous-cell cancer type, and 2 were classed as slightly differentiated or undifferentiated, without definite epithelial structure. He proceeds to explain that in his classification of the fibromyxo-sarcomatous type of mixed tumor, it is probably only a sarcoma structurally, and that if a complete search were made of the tumor, eventually epithelial cells would be found. It is noted that he did not classify his tumors as adenocarcinomas, but of adenocarcinoma type, since more or less pronounced tendencies to form other structures are found in these. He discusses further that the names basal-cell and squamous-cell carcinoma are used because the predominant feature is that of basal-cell and squamous-cell carcinoma respectively. Due to the histological variation in these tumors, and within the same tumor, it is no wonder that Ahlbom is not positive that his classification is correct. He expresses his idea of the relation of all the tumors of the mucous and salivary glands by saying that, "The numerous histological transitions and the mixture of different structures mentioned have taught us, as a sort of compensation for the difficulties they caused in classification, that all these tumors of the mucous and salivary-gland group are intimately related. We have come to understand more and more clearly how justifiable and necessary it is to regard them as one common large group". MacFee classifies malignant tumors of the salivary glands as: (*a*) mixed tumors with malignant changes, (*b*) basal type tumors, (*c*) papillary cystic tumors; (*d*) adenocarcinomas; (*e*) squamous cell carcinomas; and (*f*) a heterogeneous group which does not fit into any of the other classes. It appears then, that his classification and that of Ahlbom are essentially the same. MacFee states that these malignant tumors do show a correlation between their clinical behavior and histological structure. One of his statements, in which he says that the metastases usually appear in a simpler form would lead one to follow Ahlbom's idea that structurally, the primary tumor may appear as one type, when actually it is another. Another statement by MacFee that these tumors have little tendency toward distant metastases or regional lymph node

submaxillary gland, a wide resection is preferable to simple enucleation since there is less chance of recurrence. Patey suggests enucleation and the insertion of radium in the treatment of parotid tumors, since there is danger of severance of the facial nerve and damage to other tissues in this region. Taylor and Garcelon advocate radical removal of the gland in mixed tumors of either the parotid or submaxillary. In the early stage of carcinoma, they favor wide excision, but preserving the facial nerve in the case of parotid involvement. When carcinoma is diagnosed during operation, they advocate radical measures at once, even to the extent of sacrificing the facial nerve in parotid tumors. Patients with remote metastasis and wide fixation of the carcinomatous lesion are treated with a combination of surgery and radiation applicable to the individual case, even though they find little value in radiation therapy. Adson and Ott describe a technic for preserving the facial nerve in radical excision of parotid tumors. An extra-oral incision is made downward from the zygoma, in front of the ear, but behind the parotid. This intersects another curved incision which extends from 4 cm. anterior to the angle of the jaw on the lower border of the mandible, upward and backward to a point 3 cm superior and posterior to the lower tip of the mastoid process. The facial nerve is ultimately located by first locating its inframandibular branch, then dissecting upward until its temporal and cervical divisions are located. These divisions are dissected through the parotid, the parotid elevated, Stensen's duct ligated, then the parotid removed from the skin. The part of the parotid which lies medial to the ramus is removed by a lateral elevation of the facial nerve, and dissecting the parotid mass, which lies medial to it If the neoplasm has involved the skin, that part may be removed along with the removal of the parotid just mentioned. Certainly when it is impossible to demonstrate the lines of cleavage because of malignant involvement with necrosis, the facial nerve may be justifiably sacrificed. Ahlbom, being primarily interested in radiotherapy goes to great length to describe the technical procedures incident to the usage of this at Radiumhemmet in Stockholm, Sweden. His technics include roentgen treatment, teleradium treatment, surface radium, intratumoral radium and the application of radium in the cavity after removal of the tumor. One of the primary principles used by him in these types of treatment, is that malignant tumors should not receive such intensive dosages of radiation as to reduce the local and general protective mechanism of the individual against the disease. In those cases where radiation fails to obliterate the tumor, unless

to be freely movable, firm, resilient, and one mass. The malignant tumor, on palpation, is usually rather hard and fixed to the under structures, but may be fixed onto the skin. On the other hand, some adenocarcinomatous tumors may be quite soft. Malignant papillary cystic tumors are rather characteristic in that they have an elastic consistency, a smooth surface and a rather spherical form. The squamous cell cancer type follows the most typical carcinomatous course of any of the salivary malignant neoplasms. They are usually hard, often ulcerated quite extensively, and show a great amount of infiltration. History of the tumors may show that the carcinomatous type has been present for a relatively shorter time than the mixed tumors. Ahlbom states that "no definite conclusions can be drawn from the presence of metastases or their localization as far as the differentiation of the different types is concerned". Mulligan states that he believes that metastases are more common in mixed tumors than is ordinarily believed. In his study of 20 cases of mixed tumors with metastasis, he found the most common sites to be the lungs, pleurae, liver, bones, lymph nodes, kidneys, and spleen, in that order of decreasing frequency. Diagnostic aids include roentgen examination, primary effects of radiation, and biopsy A roentgen examination helps to determine the extent of bone destruction in malignant growths, and by the use of opaque fluids in the excretory ducts, a differential between sialadenitis and tumor might be effected The effects of radiation may be a valuable aid in differentiating between malignant and benign salivary gland tumors, since the former show greater radiosensitivity in general than do the latter. Biopsies have some serious drawbacks in relation to this group of malignant lesions. Taking the biopsy itself causes the patient pain, may stimulate activity of the tumor, and spread tumor cells, and where small pieces of tissue are obtained, a diagnosis from the biopsy might be misleading This is in keeping with our having discussed the complexity of the histopathology of these tumors. Salivary gland malignant neoplasms must be differentiated from tumors of the jaw, inflammatory conditions, branchiogenic cysts, and tumors and involvements of lymph nodes in close proximity to the salivary glands from various conditions.

A variety of treatments is to be expected in dealing with neoplasms of such a complex nature as these. MacFarland advocated the excision of every tumor as soon as possible because of the existence of potentialities for harm, and the fact that removal of smaller ones was less disturbing to the surrounding structures. It is the opinion of the author that in cases of primary tumors in the

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dosages are given that will endanger the approximating tissue, surgery in combination with radiation is employed. Authorities agree that, in some cases, surgery and radiation together give better results than either used alone. This method has been adopted as standard treatment of malignant tumors of the salivary glands in a number of clinics.

It is concluded from the foregoing, that in dealing with cancer of the salivary glands, we are dealing with a complex type of malignancy that does not always show its true picture by histological or clinical examination and that, in the final analysis, the real criteria for its malignancy are the course it ran and the damage done.

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intermediate products of carbohydrate metabolism are thought to have a catalytic action in fat metabolism. The best sources of carbohydrates are grain products, all ripe fruits and vegetables. All carbohydrates are not in the available form for digestion in the human body. For example, the soluble crystalline group are available, while the cellulose and hemocellulose are not. The non-available ones are important in the diet, however, as a source of roughage, rather than food value.

Fat is an essential constituent of every body cell. It is also an energy supplier like carbohydrates and has a protein-sparing action. By weight, fat supplies twice as much energy as carbohydrates, giving 9 calories per gram. Again, as in the case of carbohydrates, the daily requirement will vary, but the average adult requirement ranges from 1 to 2 grams per kilogram of body weight. The amount required will depend upon the degree of activity and the amount of carbohydrate in the diet. The best sources of fat are dairy products, nuts, and some vegetables such as the avocado.

Minerals are essential in the diet and are found in both the hard tissues (teeth and bone) and soft tissues. They are found in more minute quantities than are the other foodstuffs discussed previously. They have many functions as well as being the foundation of bone and teeth. For example, they are important in governing the osmotic pressure, essential for the correct function of the body musculature, regulating the threshold of stimuli and are important in regulating body secretions as well as being a part of them.

Vitamins are perhaps the most overrated of all foodstuffs because of high pressure advertising. On the other hand, it has been proved experimentally, and otherwise, that in order for the body to function normally, vitamins must be present in the diet. Different vitamins have been discovered and produced synthetically and most certainly there are many more that have not been discovered. It is beyond our scope here to discuss, in any detail, the vitamins as to source, requirements and function, however, it should be remembered that in the preparation of any diet (normal or therapeutic) vitamins are stored to a limited extent in the body and therefore should be taken at regular intervals.

Water, perhaps, cannot be considered as a food, but as something to aid thirst. This is far from being the complete story because all metabolic substances (both catabolic and anabolic) must be water soluble before they can be assimulated or excreted. Water is also important in regulating the body temperature, pH, ionization and osmosis. There are three sources of water. They include drinking water, water content of foods, and metabolic water. The supply

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Diet for Cancer Patients

THE following paragraphs will concern chiefly what we might recommend as food for our cancer patients. However, the daily food requirements of the body and the food constituents necessary to fulfill them must be considered. These factors are of utmost importance in all dietetic treatment, both normal and therapeutic The body requires certain food constituents such as proteins, fats, carbohydrates, minerals, and vitamins regardless of whether it is normal or whether certain pathological conditions are present. This is especially true when diets are being considered for cancer patients, because their body resistance is already at a very low ebb. Due to the fact that many of these patients are affected in such a manner and in such regions of the body that these food constituents cannot be consumed in a normal manner, a problem is presented. This problem along with preoperative and postoperative feeding will be the chief considerations.

Perhaps no one food can be considered as the most important, because the body will not thrive with one in absence. However, proteins are often said to be most important, because they are required in every cell and are the basis of all living protoplasm. Various investigators have shown that the average normal adult requires about 1 gram of protein per kilogram of body weight per day. Of course, various types of pathology would alter this, usually the amount being increased The best sources of proteins are eggs, meats, milk and vegetables Meats have a higher "coefficient of digestibility" than vegetables and are more important in supplying the body with the essential amino acids than vegetables. The importance of milk in supplying proteins is in a category of its own, since milk is the sole diet of an infant.

The carbohydrate requirement will vary with such factors as type of work, physical health, age, sex and climate, however the average person should ingest about 300 grams of carbohydrates per day. The main function of carbohydrates is to supply energy. They are also a good source of fat and act as a timely factor in splitting nitrogen off the amino acids in protein metabolism. The

The first point of importance to remember in the diet for the cancer patient is in regard to the action of the bowels. With a perfect vegetarian diet, there may be less danger of trouble in this direction.

The diet for the treatment of the cancer patient is hardly encouraging because of the absence of definite knowledge of the etiology of cancer; therefore any dietetic treatment must be empirical and many methods of diet have been tried to combat the disease. Some men have thought that cancer was more frequent among people who were great meat eaters. On the basis of this knowledge, Kessler designed a diet low in sulphur. His diet is as follows:

BREAKFAST:—Tea or coffee with sugar and cream. No milk on account of lactalbumin which is high in sulphur. Fresh or cooked fruit. A cereal, either wheat, oatmeal or rice.

DINNER:—Soup or fruit, cereals, or vegetables (not meat). Beans, peas. Meats, two ounces at most. Potato dumplings, carrots, beets or other edible roots. Boiled or preserved fruits to bring up the protein to normal.

SUPPER:—Fruit with rice, potatoes and butter, salads. Kessler allows for a selection of nitrogenous foods to choose from as follows:

Fish:—Salmon, white fish, cod, mackerel, herring, shad, black fish, Spanish mackerel and porgy. No meat of blood (rich in sulphur). Buttermilk is bad, as is egg yolk.

Vegetables allowed are. Truffles, rhubarb, beets, chicory, pumpkin, lettuce, beans, peas, romaine salad, chestnuts.

Cereals:—Wheat, oatmeal, rice, cornbread, barley, buckwheat, poppy seed, graham bread.

Fruits·—Almonds, olives, plums, oranges, huckleberries and strawberries.

Packard, in 1912, called attention to a point that the great increase in cancer apparently followed the use of foods which had been apparently demineralized. These foods that are robbed of an essential part are wheat, rice, potatoes peeled or cooked by boiling. Packard believed in this theory and gave to some of his inoperative recurrent cancer cases a diet rich in minerals. He believed there was some arrest of the disease and a condition of good health. His diet was as follows:

(1) Exclude all white flour bread and all articles into which white flour enters. Bread should be made from whole wheat flour.

(2) Potatoes—One or two baked potatoes daily The heart portion of the potato should be discarded and the peripheral portions eaten, because they are rich in minerals which are located immediately beneath the skin.

must be sufficient and will vary with such factors as diet, age, type of work, climate, pathological conditions and the like.

In the preparation of diets for any individual, food allergy and idiosyncrasy are problems to consider. Many patients are not concerned with these problems; however, there is a certain percentage who will respond quite readily to the smallest amount of some foods. This is especially true in cases of food allergies. The food or foods that bring them about must be eliminated from the diet entirely and replaced by other foods so that all the essentials are made available. Food allergies are thought to be due to underdeveloped metabolic systems. This is based upon the fact that proteins bring about food allergies more than any of the other foodstuffs, and as a group, protein metabolism is the most difficult. Another factor that seems to prove that allergic reactions are caused by underdeveloped metabolic systems is that the individual will outgrow the reaction in 75 per cent of the cases.

There has been much written about the influence of diet in the production of cancer and in the stimulation of the process once it has been initiated. There has been nothing definitely established, no matter what the relation of diet to the cause of cancer. The diet is considered now in relation to cancer from the point of view of maintaining strength, of aiding eliminations, and of stimulating appetite. The diet must be wholesome and varied to accomplish these purposes. There should be no particular article of food omitted and there is no particular constituent of any article of food given in moderation that may be said to be harmful. Salt has been eliminated by some from the diet. Alcohol beverages have been completely eliminated from the diet in any stage of the diet by others, yet Bainbridge states from his own experience that it may be taken in moderation, with food, serving as an appetizer

Buckley stated, "Dietetic and medical treatment of cancer, in the fullest sense, have never yet been given a fair and fully intelligent trial on a scale large enough to produce general conviction in regard to their value". He believed that for the proper treatment of cancer it is absolutely necessary to maintain a perfect vegetarian diet. Eggs and milk with food should be excluded. The yolk of eggs may be given sometimes and milk alone and separate, at the body temperature, one hour before eating. The diet should be arranged to give the required amount of calories, in proper proportion of vegetable protein, carbohydrates, and fats. Fats should be given in the form of butter; one-quarter of a pound could be given daily.

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SUPPER:—Fruit with rice, potatoes and butter, salads. Kessler allows for a selection of nitrogenous foods to choose from as follows:

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Vegetables allowed are: Truffles, rhubarb, beets, chicory, pumpkin, lettuce, beans, peas, romaine salad, chestnuts.

Cereals:—Wheat, oatmeal, rice, cornbread, barley, buckwheat, poppy seed, graham bread.

Fruits:—Almonds, olives, plums, oranges, huckleberries and strawberries.

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(1) Exclude all white flour bread and all articles into which white flour enters. Bread should be made from whole wheat flour.

(2) Potatoes—One or two baked potatoes daily. The heart portion of the potato should be discarded and the peripheral portions eaten, because they are rich in minerals which are located immediately beneath the skin.

(3) He encouraged well-cooked fresh vegetables, apples, raw or cooked in any way, and fresh ripe fruits.

(4) Meats and fish may be used to a moderate degree.

There must be a normal amount of protein included in the dietary. If it is not taken in fresh foods or in vegetables, it must come from foods as eggs, cheese, milk, and leguminous vegetables.

The following vegetarian diet was suggested at one time by Buckley at the New York Skin and Cancer Hospital. There is a minimum amount of protein and the menus average 2100 calories per day.

FIRST DAY

Breakfast

4 oz. Rice
3 oz. Corn Bread
1¼ oz. Butter
½ oz Hot Water

Dinner

5 oz. Vegetable Soup
3 oz. Baked Potato
3 oz Stewed Celery
1 oz Graham Bread
1¼ oz. Butter
1 Fresh Apple

Supper

4 oz Rolled Oats
2 oz White Bread
1¼ oz Stewed Prunes
¼ oz Sugar
Very weak tea

SECOND DAY

Breakfast

Orange
4 oz Hominy
2 oz Graham Toast
1¼ oz. Butter
Postum

Dinner

5 oz. Pea Soup
3 oz Macaroni
3 oz. String Beans
2 oz. Bread
1¼ oz Butter
Dates

Supper

4 oz Cream of Wheat
2 oz. Graham Toast
1¼ oz Baked Apple
¼ oz. Sugar
Very weak tea

THIRD DAY

Breakfast

Banana
4 oz. Pettijohn
2 oz. White Bread
½ oz Sugar
Hot Water

Dinner

3 oz. Baked Potatoes
5 oz Corn Soup
3 oz. Spinach
3 oz Boiled Onions
2 oz. Bread
1¼ oz Butter
Raisins

Supper

4 oz. Farina
4 oz. Stewed Figs
2 oz. Graham Crackers
1½ oz Butter
Very weak tea

FOURTH DAY

Breakfast

Raw Apple
4 oz. Cornmeal Mush
2 oz Graham Bread
1¼ oz Butter
½ oz Sugar
Postum

Dinner

5 oz. Vegetable Soup
4 oz Baked Beans
7 oz. Cauliflower
3 oz. Asparagus
1¼ oz. Butter
Orange

Supper

4 oz Rice
4 oz Stewed Prunes
2 oz. Graham Crackers
1¼ oz Butter
¼ oz. Sugar
Very weak tea

FIFTH DAY

Breakfast

Orange
4 oz Cracked Wheat
3 oz Corn Muffins
1¼ oz Butter
½ oz Sugar
Hot water

Dinner

5 oz Sago Soup
4 oz. Spaghetti
3 oz. Lima Beans
3 oz Boiled Onions
1¼ oz. Butter
Dates

Supper

4 oz Cream of Wheat
Sliced Orange
2 oz Oatmeal Crackers
1¼ oz. Butter
¼ oz Sugar
Very weak tea

SIXTH DAY

Breakfast

4 oz Soup
2 oz Graham Toast
1¼ oz Sugar
Postum

Dinner

5 oz Celery Soup
4 oz. Baked Potatoes
3 oz Carrots
3 oz. Spinach
1¼ oz Butter
2 oz. Bread
Figs

Supper

4 oz Wheatena
4 oz Stewed Figs
2 oz Uneeda Biscuit
1¼ oz Butter
¼ oz Sugar
Very weak tea

(3) He encouraged well-cooked fresh vegetables, apples, raw or cooked in any way, and fresh ripe fruits.

(4) Meats and fish may be used to a moderate degree.

There must be a normal amount of protein included in the dietary. If it is not taken in fresh foods or in vegetables, it must come from foods as eggs, cheese, milk, and leguminous vegetables.

The following vegetarian diet was suggested at one time by Buckley at the New York Skin and Cancer Hospital. There is a minimum amount of protein and the menus average 2100 calories per day.

FIRST DAY

Breakfast

4 oz. Rice
3 oz. Corn Bread
1¼ oz. Butter
½ oz. Hot Water

Dinner

5 oz Vegetable Soup
3 oz. Baked Potato
3 oz Stewed Celery
1 oz Graham Bread
1¼ oz. Butter
1 Fresh Apple

Supper

4 oz Rolled Oats
2 oz. White Bread
1¼ oz. Stewed Prunes
¼ oz. Sugar
Very weak tea

SECOND DAY

Breakfast

Orange
4 oz Hominy
2 oz. Graham Toast
1¼ oz Butter
Postum

Dinner

5 oz. Pea Soup
3 oz. Macaroni
3 oz String Beans
2 oz Bread
1¼ oz Butter
Dates

Supper

4 oz Cream of Wheat
2 oz Graham Toast
1¼ oz. Baked Apple
¼ oz. Sugar
Very weak tea

THIRD DAY

Breakfast

Banana
4 oz. Pettijohn
2 oz. White Bread
½ oz. Sugar
Hot Water

Dinner

3 oz Baked Potatoes
5 oz. Corn Soup
3 oz. Spinach
3 oz Boiled Onions
2 oz Bread
1¼ oz Butter
Raisins

food of the proper type be swallowed. It is possible to prevent esophageal residues, if from 6 to 10 small feedings daily are administered. As the stenosis becomes marked, it is advisable to give small feedings every hour. These feedings may be as small as 1 ounce or a dessert-spoonful. If painful spasms result during swallowing, it is advisable that the raw surfaces be protected by the administration of such medicines as orthoform or bismuth nitrate about a quarter of an hour before feeding and small doses of tincture of belladonna.

When cancer involves the lower end of the esophagus, painful dysphagia is usually the result. Esophageal retention, particularly of solid or semi-solid foods, may be the first sign of the disease—very soft or liquid foods causing the least disturbance.

The first essential in medical treatment of cancer of the stomach is regulation of the diet. This should be done carefully, but no absolute rule can be made. There must be a dietary for each patient. As a general rule, food should be given in small amounts and in the most digestible form. Liquids must be given sparingly. The thirst of these patients is troublesome, and for this the best treatment is to give hot water one-half hour before meals, or liquid may be given by rectum. Milk is often taken well in small amounts. There are various modifications that may be tried if the patient cannot take raw milk. The addition of salt to the raw milk, or boiling the milk and then adding salt will often render it more palatable. Extracts of meats and soups are usually good and easily taken by the patient. The coarser varieties of meat should be omitted. The meats should be of the finely minced type. Eggs in any form are good Fats should be omitted in most cases. The peptonized foods may be given as far as possible if necessary The carbohydrates should be omitted to a great extent because of discomfort through fermentation. Vegetables may be given very sparingly and the coarse ones should be omitted. In cases where there is a desire for something of the vegetable nature, stewed fruits are useful. There may be an indulgence as far as possible for the longings for special articles of the diet as long as it is not too frequent because the gratifying of these desires has often a very comforting effect on the patient's general condition. Nutrient enemata may be given when necessary. In cases with a growth obstructing the cardia, or with stenosis of the pylorus, the diet should consist of liquids and should be given in small amounts.

These growths at or near the cardia frequently call for a very soft diet or liquids may be given through a long catheter, or a small tube of a small caliber passed beyond the constriction. This method of feeding may be used constantly. There are extensive,

This bill of fare may be repeated on successive days and some interchange on different articles may be made. There should be nothing taken between meals, unless especially directed Life should be simple and as healthful as possible with long bed hours.

Cancer of the Esophagus—Before a dietetic regimen is prescribed in this or any other affection, a correct diagnosis must be made. Not infrequently, instances of so-called cancer of the esophagus are proven on a careful examination to be some other condition such as diverticula, cardiospasm with diffuse dilation of the esophagus, mediastinal tumor, benign ulcers or strictures associated with lues. A differential diagnosis in these cases may be aided by roentgenograms. They readily serve to differentiate such affections from true malignant diseases of the esophagus.

The essential dietetic requirements in esophageal cancer are that the food should, if possible, be chosen by the patient according to his likes, that such food should be thoroughly softened by mastication or already soft or fluid in nature, that it should not be extremely hot or cold, which state would make it capable of producing painful spasms, and definitely no food having tough fibers or hard, sharp edges, should be swallowed.

For the purpose of comment we might classify the region involved in the esophagus as to upper, middle and lower thirds. If the lesions are present in the upper third, it may be necessary from the first to introduce the food into the esophagus by means of a small soft stomach tube, a soft catheter, or a duodenal bulb of the common type. This small tube may be left in place for many days, even weeks, and nourishment of sufficient quantity given without annoyance to the patient. If this type feeding is carried out in the early stage of this affection, it is possible that some beneficial sloughing of the malignant growth will occur and the inflammatory edema will disappear, so that later the patient may be able to take food without the tube for a considerable length of time. When the patient is able to swallow, care should be taken that the swallowing function be tested first by the administration of liquid foods before a very soft or partly solid diet is administered. If this arrangement is followed, then the avoidance of annoying retention is certain and the possibility of regurgitation of food from the upper esophagus into the larynx or lung prevented

If the malignant growth lies in the middle one-third of the esophagus, liquid or very soft foods are usually tolerated until there is a definite stricture with obstruction Until this happens, it is well to let the patient choose his own diet from a supplied list of soft or liquid foods. However, it is quite necessary to insist that sufficient

Maltose Or 30.0 grams.
Alcohol (95 per cent) or 20.0 grams.
Peptonized milk or 100.0 cc.
Normal salt solution q s. al VIII or 240 0 cc.
Mix Heat to 37° C
Sig. Administer slowly.

The diet is very important in the postoperative care of surgical treatment of cancer of the stomach. It is important to carry out a definite plan in order to prevent deaths. An ounce or two of broth, or water gruel may be given by mouth on the third day every two hours. This may be continued for three or four days, then an ounce or two of buttermilk with an ounce or two of cream may be given once or twice during the day. Later an ounce or two of a white of an egg may be given with an amount of orange juice and water to disguise the egg. After ten days milk and milk of magnesia may be given regularly and the patient may chew beef or mutton, but should not swallow anything but the juice. These patients should always be cautioned not to eat raw fruits or vegetables after they leave the hospital. They should be given a definite diet list which they may resort to when they cannot digest a regular diet. A regular diet or normal diet for these patients is as follows·

1. Drink no water and no other liquid except hot milk during meals, not for one hour before or after meals.
2. Drink an abundance of good water between meals.
3 Drink no tea or coffee, and nothing containing alcohol.
4. Eat very slowly and chew all food for a long time.
5. Eat nothing very sweet or very sour.
6. Eat nothing that has been fried.
7 Eat no hot bread, cake, candy, canned goods, pickles, pancakes, puddings, pies, pastry or pork, no raw vegetables or raw fruits, no bananas, baked beans and no nuts.
8 They may eat broiled or stewed beef and mutton, breast of chicken, fish, cooked vegetables, cooked ripe fruits, bread, butter, toast, well-cooked cereals, rice, milk or cream soups and vegetable soups and soft-boiled or poached eggs. They may drink milk, cream and buttermilk. Milk of magnesia or lime water should be added to the milk in order to prevent it from coagulating in the stomach and in order to alkalinize the milk

The moment the patient feels any distress, he should use the following diet to give the digestive apparatus the rest it needs.

1. Chew all food for a long time. Eat no sweets or sours.
2. Take ½ pint of hot milk with one or two teaspoonfuls of milk of magnesia at hours 6, 8, 10, 12, 2, 4, 6, and 8.

canalized growths in the body of the stomach that often allow the exhibition of well-chewed mixed food for a long period of time. When pylorus stenosis has occurred, it may be impossible to get a proper quantity of food beyond the stomach By the use of metagastric alimentation considerable relief from discomfort and sufficient nutriment may be obtained. This may be of service where it is possible for the bulb of the "duodenal tube", or the end of the post-gastric catheter to pass beyond the pylorus. There are many instances when the tube does not pass through the pylorus and in many cases in which this mode of feeding is most desirable, there is a mechanical interference with its success. The form of a post-gastric catheter passed directly into the small bowel is the best. One can be reasonably sure the food is reaching the desired location. Various mixtures that are nourishing may be administered by the metagastric method. The most common ones are. parboiled milk, cream, buttermilk, malted milk, koumiss, wines, cocoa, chocolate, thin purées, clear broth, egg-nog, predigested foods, fruit juices, sugar water, barley-water, black coffee, tea, carbonated preparations, and special formulae. There is a wide range from 2 to 8 ounces administered at a time This material should be passed in slowly and should be at 37° C. Mixtures of amino acids and maltose have been given by the metagastric method when emaciation was marked.

The essential feature of successful dieting is to allow only such foods as will cause little irritation and will pass through the stomach leaving the minimum of residue Any lumps of food are likely to cause irritation, produce or keep up hemorrhage, and by stagnation in the stomach may furnish an ideal culture media for a host of inimical bacteria. Foods should not be too hot or cold Cold foods may cause painful gastro-spasm, while hot foods may cause gastric congestion or even hemorrhage in cancer. Vegetables and fruits should not be given to the cancer patient uncooked They are mechanical irritants and also a common source of infection.

The rectal feeding method may be required after hemorrhage, where there is pain in "Coma Carcinomatosa", where there is exhaustion due to loss of appetite, nausea, vomiting, alloy thirst and starvation due to stenosis. The method that is considered to be best for rectal alimentation is the "Murphy drip" method Four to eight ounces of nutrient fluid may be given at intervals of from four to six hours. There are various formulae for nutrient enemata, but the following have been found useful: (Given by Smith and Ochsner).

7 or 8 ounces, 1 egg and a tablespoonful of lactose. The lactose may be omitted if diarrhea develops. Butter may be added if the patient loses weight. There may be some reason that the patient cannot take milk; then gruels may be substituted, but one must always be sure the feeding is free from lumps. The number of feedings is eight a day at two-hour intervals and feedings must be given slowly, taking about twenty minutes for each. The food should be strained and given at body temperature. The patient will be moie comfortable if a very thin tube is used. A diet for duodenal feeding as recommended by Einhorn is as follows:

7·30 A.M.	Oatmeal	15 gm (½ oz)
	One egg	
	Butter	
	Lactose	
9·30 A M.	Pea Soup	180 cc (6 oz)
	One egg	
	Butter	15 gm. (½ oz)
	Lactose	15 gm. (½ oz)
11 30 A M	Same as 9 30 A M	
1:30 P M	Bouillon	180 cc (6 oz)
	One egg	
3·30 P M	Oatmeal gruel	180 cc. (6 oz)
	Butter	15 gm (½ oz)
	One egg	
	Lactose	15 gm. (½ oz)
5 30 P M	Same as 9 30 A.M.	
9 30 P M.	Bouillon	180 cc (6 oz)
	One egg	

The total calories—4335

The diet in the treatment of cancer of the stomach is for the chief purpose of promoting the comfort and nourishment of the patient after operation or when for any reason operation is inadvisable as in the case of metastases in the liver or other organs. One may conclude that the dietary regimen should be determined in some measure by the nature, the functional disturbance or location of the cancer. The same dietary precautions and the same food should be prescribed in cancer of the stomach as advised in chronic gastritis. The feedings should be small but frequent. Vegetables should be given only in the form of purées Very often it is possible to maintain a good state of nutrition in these patients for a considerable period of time if careful attention is given to the diet The following lists have been found useful in many cases by the authors in the treatment for cancer of the stomach.

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3. First week: Four pints of hot milk daily with milk of magnesia or lime water and one to four raw eggs may be added if needed for patient's strength.

4. Second week: Same as first except two or four eggs raw or soft-boiled may be added.

5. Third week: Same as for the second week except two to six pieces of very dry toast is added.

6. Fourth week: Same as third with the addition of all kinds of milk and cream soups.

7. Fifth week: Same as fourth with all kinds of mush or boiled rice added.

8. Sixth week: Same as fifth. Broiled, stewed or boiled beef or mutton added. The fibers should not be swallowed, only the juice.

9. Later add cooked vegetables and cooked fruits. adding only one kind each week.

10. Later the beef or mutton may be swallowed.

11. Even after recovery, pastry, pies, pancakes, pickles, pork, cakes, candy or canned goods should not be eaten. No raw vegetables or raw fruits unless the fruits are perfectly ripe and not sour.

The diet in the treatment of cancer of the stomach is not a curative in this condition, but certain modifications of the bland diet may add greatly to the patient's well-being and comfort. The diet must always be adapted to the general condition of the patient. If a gastric secretion is decreased or lacking. a diet would be indicated for hypochlorhydria; if there is an increased secretion there would be an indication for hyperchlorhydria. A liquid diet may often be suitable for the patient's needs. In cases of cancer where hyperacidity is involved there should only be given moderate amounts of meat products unless there are further contraindications.

It has been mentioned in the preceding paragraphs that the foods should always be soft and non-irritating; this is particularly true when ulceration is evident. This diet should be that of a peptic ulcer diet. The quantity need not be reduced except in the presence of rather extreme ulceration because there is no chance of healing a carcinomatous ulcer by diet. Most important is to keep up the patient's nutrition to as high a degree as possible, with suitable liquids, semi-liquids and soft food Where the ulceration is extreme or the anorexia is so severe that nutrition is interfered with out of proportion to the development of growth, duodenal feeding may be advisable and good results may be obtained This method of feeding was devised by Einhorn who recommended it in cases of inoperable carcinoma of the stomach where the pain is great. He recommended regular feedings that consist of milk,

The above diets were recommended by Friedenwald and Ruhrah.

Preoperative and postoperative feedings have been considered briefly, and at this point an over-all picture of dietetic management of surgical cases will be presented. Most surgical operations may be postponed for several days or longer, thus enabling the patient to be put in good condition by rest, preferably in bed, and a nourishing, easily digested diet. This is particularly true in cancer operations, because a few days in the "building up process" would perhaps benefit the patient to a higher degree than immediate operation.

The diet on the day previous to the operation should be light. On the morning of the operation a glass of milk or a cup of weak cocoa or beef-tea should be given. There is no objection to adding a small piece of toast, a biscuit, or a cracker. This should precede the operation by at least three hours. If the operation is performed early in the morning, nothing should be given before it. If a general anesthetic is administered, the supper should be a light one, and nothing but water should be given for at least six hours before the operation. Water may be given freely up to the time of the operation. The reason it is necessary to have the stomach empty during the operation is to lessen the tendency of nausea and vomiting that may follow the operation.

There are many erroneous views concerning the diet suitable after operations. These views are held by many physicians and many of the surgeons consider their duty done when they remove their operating gowns. The after-treatment of operations is then often delegated to untrained men who are uncertain of the diet and leave it entirely up to the nurse. On the other hand, the surgeon should supervise the follow-up diet or should place the responsibility upon an assistant who has been specially trained for the purpose. The type of diet may well depend upon the area of the body that was operated upon. For example, if the operation was about the head and the brain involved, for the first few days the diet would be light—usually liquid—and as nutritious, and easy to digest as possible to make it. The bowels should be kept open and no alcohol should be allowed except in those cases where the patients are chronic alcoholics, then they should be given a minimum amount based upon their previous daily average. After the first few days, a semi-solid or an easily digestible solid diet may be allowed. Milk-toast, junket, bouillon, soft-boiled or poached eggs, squab, chicken and the like are allowable. Even though the diet is light, it must be sufficient in quantity and quality until the patient is up and about. In many cases, the patient may not be able to

Boas' Diet List

8 A.M.	100 gm. milk and tea, and 10 gm. butter	336 60 cal
10 A.M.	100 gm. broiled perch	71 80 cal
	50 gm toasted bread	129 90 cal
	or 100 gm. calves' brain (140) sweet bread (90) 2 eggs (160)	
12 o'clock	150 gm. milk & rice	260 00 cal
	100 gm. veal	142 45 cal
	50 gm macaroni	126 30 cal
3 P.M.	100 gm. tea and milk (67 5) 50 gm. cakes (187)	254 50 cal
7 P.M.	100 gm. cream	214 60 cal
	50 gm zwieback, 10 gm butter, 30 gm. ham	376 30 cal
9 P.M.	50 gm. cream	107 30 cal.
	Total	2019 75 cal

Wegele's Diet List

Morning	150 gm. Maltoleguminose cocoa
Forenoon	200 gm. Kefir
Noon	150 gm. Maltoleguminose soup
Afternoon	150 gm. Maltoleguminose cocoa
Evening	100 gm. Scraped ham
10 o'clock	200 gm. Kefir
	with cocoa, 30 gm honey
	with Kefir, 20 gm Cognac
During the day:	50 gm zwieback
	Entire number of calories 1260

Cohnheim's Dietary List

7 A.M.	Milk soup, cooked with cream and butter Biscuits with butter	
9 15 A.M.	Tea and cream, butter, rolls, scraped ham, and a soft egg	
12 o'clock	Rice broth or soup, purée of spinach, carrots, or peas; chopped chicken, broiled calves' brain or fish, and some sweet fruit sauce	
3 P.M.	Cocoa with cream and butter, cakes	
5 30 P.M.	A cereal soup or broth, containing much butter	
7:15 P.M.	Tea with plenty of cream, scraped ham and buttered rolls	
Breakfast	½ liter milk, 40 gm toast, 10 gm butter	504 cal
Luncheon	Oatmeal soup, 15 gram purée	90 cal
Noon	Vegetable green soup, 1 yolk of egg finely hacked; 40 gm toast, 100 gm. mashed potatoes	677 4 cal
Afternoon	¼ liter milk cocoa, 1 yolk egg 30 gm zwieback	400 cal
Evening	Flour milk gruel, viz 250 gm milk, 20 gm tapioca. Oatmeal, 15 gm , 50 gm. toast	320 cal
	Total Calories	1991 4

Perhaps nutrition in relation to tumor growth should be mentioned briefly at this time. In this regard only one fact appears to have been definitely established, namely, the promotion of tumor growth due to caloric overfeeding and the opposite effect, as a consequence of caloric restriction However, if the food intake is restricted, vital foodstuffs are not consumed and the patient is subjected to such dietary measures that threaten death by starvation, because as high as 20 per cent decrease in caloric intake has no effect on the rate of growth, but a 50 per cent decrease has a marked inhibition on the tumor growth. This makes such dietary treatment practically an impossibility.

In conclusion, it is well to emphasize the fact that all living tissue must be fed adequately, with the proper foods, to function normally; that the requirements include an adequate supply of each; that dietary requirements are affected by disease—usually increased—and that failure to meet the requirements of the tissues must occasion some degree of malnutrition in every instance. This is the reason that nutrition is becoming an important role in the treatment of many diseases, especially cancer. Cancer presents many problems regarding proper nutrition because many times it involves one of the vital organs of digestion, or other organs that are responsible for normal metabolism. It has also been pointed out that before and after surgical treatment, nutrition is one of the important factors in the determination of the success of the operation, and by no means should nutrition in treatment of any disease or condition of the body be overlooked.

Taking in consideration the above, it is well in any disease to first plan for the nutriment of the patient, prescribing nothing of a counteracting ability for the drugs that are to be used.

Cancer is a demanding disease, drawing from the patient throughout its stages, much that is valuable to life Let us not then forget to endeavor to the utmost of our ability to replace that which we may to keep the body defense well reinforced.

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take the food orally, then he may have to be fed intravenously, rectally or through a stomach or nasal tube. A very good example of this could be seen in cases where the operation was done in such regions of the face so that the intake of foods or vomiting is apt to open the wound. The food should then be given by rectum until all danger of vomiting is past and until the patient can masticate and swallow without fear of injuring the part.

Since such terms as liquid diet, soft diet, light diet, and other type diets have been referred to quite often in this chapter, perhaps it would be proper to briefly explain what these terms mean A surgical liquid diet is one which is inadequate when strictly concerning nutrition, but plays an important role in replacing the fluids which have or might have been lost due to the operation Solid foods of any kind fall under the heading of an offending factor and only such fluids as water, tea, coffee, fat-free broth and jello or gelatin water are included. Sometimes milk and fruit juices are included even though they may be harmful in a strict liquid diet.

Restricted liquid diet is a little more liberal than the surgical liquid. Milk is usually excluded; however, fruit juices, thin cereal waters, strained fruit gelatins, and albuminized fruit juices may be taken. It is also deficient in proper nutritional factors and should not be continued any longer than necessary.

A general liquid diet can be made entirely adequate and be used over a long period of time without danger. If this type diet is prepared properly, it will not only nourish the patient, but also place little strain upon the digestion. Milk makes up a large part of this diet along with soup, egg-nog and the like

Surgical soft diet acts as a bridge between the liquid diet and the general soft diet and foods are increased as quickly as the patient's condition permits. Such foods as stewed fruits and toast are permitted.

A general soft diet represents the necessary dietary step between acute illness and convalescence The patient has not recovered enough to permit a regular tray, but has improved to the extent to make a liquid diet unnecessary. As a rule, a soft diet is made up of simple, easily digested foods that contain no harsh fiber or highly seasoned foods. It should be well prepared and entirely adequate from a nutritional standpoint

A light (convalescent) diet is only slightly different from the soft diet. It includes tender meats, light salads with simple dressings and a wider selection of vegetables and fruits.

A regular (full) diet is as the name suggests and is given to all patients unless orders stating otherwise are given by the physician.

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11

Treatment of Cancer

INTRODUCTION

CANCER, the most dreaded disease known to man, has used, since its first recognition, the name and symbol of the crab. The etiology and definite cure of this thief of life which knows no bounds has successfully eluded the scientific attempts of man to the present time, though fortunes have been expended concerning such.

The move against the ravages of cancer may be found in old literature and records; it definitely is not new. As early as the great John Hunter, attempts at collective medical investigation of malignant lesions were begun. Modern medical science has, however, made significant advances in treatment, the keynote being the early diagnosis and the subjection of the patient in the beginning stages to the benefits of surgery, radium or roentgen therapy.

Early diagnosis is the stressed factor of the present crusade against cancer. At present, if we have to beat this menace, early treatment must be instigated after the accumulation of a wealth of clinical observation. By linking this with intense and tireless laboratory investigations, it is hoped that significant advances will be made within our time.

The treatment of cancer is today one of the greatest subjects in the field of research. It is indeed focused upon the average person by newspapers and magazines as well as the radio and television. Certainly, it is unfortunate that there are many untimely articles on possible cures for cancer which arouse undue optimism about this disease. Cancer research is naturally many steps ahead of the actual therapeutic measures attempted upon the human being. This accounts for much sensation in the field. Nevertheless, therapeutic measures must be proven beyond reasonable doubt before any great optimism is warranted. However, it is interesting to note that only fifty years ago there were no appreciable treatments offered except the one Hippocrates knew, that of radical surgery. The use and discovery of the methods of micro-diagnosis have aided treatment and treatment planning. So we have at least progressed

in the last half century more than in all previous time. If this acceleration continues, the cancer problem can certainly be more controlled in future years.

In the past few years we have learned much of the etiology, diagnosis, and treatment of cancer but almost nothing about its effective cure. The death rate is steadily increasing at a rapid pace.

The treatment of cancer, which is a broad term, has been greatly hindered by inability of the research men to obtain the exact cause of it. They have not been able to determine why some cells become cancerous in their actions. However, we do know that "malignancy" is essentially a property of automatic division, a change in a cell physiology which develops suddenly, is transmitted to descendants, and bears no apparent relation to the agent which starts it. It is not a single disease, like tuberculosis, but is to be considered as a group.

Cancer treatment can be considered under three divisions: prophylaxis, eradication of the primary lesion and removal or destruction of metastases. The prophylactic treatment is perhaps by far the most important While research has failed to determine the exact cause of this disease, the best medical opinion of today supports the view that the essential underlying cause is long continued, chronic irritation of a physical, chemical or inflammatory nature. This theory brings a large number of cancer growths within the field of preventive treatment for potential malignant tumors.

In order to properly use the prophlyactic or preventive treatment, it is incumbent upon the doctor to be thoroughly familiar with all precancerous lesions and other related conditions which are conducive to cancer formation. To remove or avoid conditions conducive to cancer is to prevent it. Most patients after discovering something wrong will wait a year or longer before seeking medical advice or treatment. There may be many causes for this, but in most instances the reason for delay is lack of pain in the beginning stages. Cancer has usually progressed to the hopeless stage when pain first appears Thus the preventive phase of cancer treatment does not usually include pain as a symptom. The many irritants to which the body is subjected do not always cause cancer, but they give the cancer a chance to begin in many instances. An individual past thirty-five years of age who does not smoke excessively, cares for his teeth properly and keeps his mouth clean, is much less likely to have cancer of the mouth or lips than one who does not follow this course. But again, non-smokers may develop cancer and of course many persons who have smoked

excessively for years never develop the disease. The constant irritation is not the actual cause of cancer, but it seems to diminish local resistance to the cancer. Thus, as a preventive measure, it is imperative that these irritations be investigated and remedied at the earliest possible date. No single phase of cancer treatment is as important to the patient and doctor as is the early recognition and treatment of a precancerous lesion.

Once the lesion has become cancerous, the preventive treatment phase of course no longer plays a part. Treatment must now become more radical, depending on the particular case involved. Again early diagnosis and treatment is of great importance because once metastasis occurs, the prognosis for successful treatment is fair to poor, depending on the degree. Treatment of the primary lesion with no metastasis can be performed in several different ways, different authorities disagreeing as to a specific type of treatment.

The treatment for cancer is based on a combination of individual judgment and various other factors. The review of statistical studies in the literature discloses no indicated method for cancer treatment, whether it should be surgery, roentgen therapy, or gamma radiation, radon seeds, estrogens, stilbamidine, or any combination which offers the best chance for cure of a cancer patient. No method or formula has yet been devised which will indicate the best treatment for the individual patient which will consider all the features of tumor, patient and doctor The final choice of treatment rests on judgment based on a knowledge of all forms of treatment of the disease. Generally, the treatment of malignancy should come under group consultation and procedures. Men trained in all phases of roentgenology, surgery, pathology, etc., can best decide the indicated type of treatment for the individual patient by working together in tumor conferences usually located in medical centers.

The present accepted method of treatment is complete removal or complete destruction of the malignant cells. Removal, of course is accomplished by surgery of some form, and destruction of the malignant cells is obtained by irradiation of some form. Since the human body has no natural defenses against malignancies once they develop, death will usually ensue sooner or later unless surgery or irradiation can be successfully applied. The applicability of surgery and radiation do not always coincide. There are many malignant tumors that can be eliminated only by surgery, also, there are neoplasms that can be cured only by radiation methods. For some lesions, either surgery or radiation can be

utilized with good results; in others, though either can be used, one may be superior to the other. Even in the same type of tumor, one may find that, at different stages of the disease, the best method of treatment may change from surgery to irradiation or the reverse. With some tumors, various combinations of the two methods may be required to obtain the best results.

The destruction of cancerous tissue by roentgen rays and gamma rays of radium is largely a story of the individual cell. Intense doses of radiation will destroy all tissues, while weaker doses will select the more susceptible tissues for early destruction. It was found that this sensitivity existed in tissues which are growing rapidly with accompanying, increased mitotic activity, as is characteristic of neoplastic tissue. The reason tumors respond differently to irradiation is not known but some research men state that the more malignant the tumor cell the more radiosensitive it becomes and conversely. Considering the tissues of the body specifically, the degree of sensitivity may be listed as follows. The most sensitive are lymphoid cells, followed in order by epithelial cells, endothelial cells, connective tissue cells, muscle cells, and the least sensitive, nerve cells.

Roentgen radiation has the ability to produce histological changes in tissues, and death of cells. Many kinds of tumor cells are more sensitive to its lethal effects than the corresponding normal cell types from which they arise, but the intercellular mechanism by which the rays cause the death of normal and neoplastic cells is not specifically known.

No surgeon should treat any malignant structure without first asking himself if the lesion might not be aided in a greater way by the use of radio-therapeutic measures instead of, or in combination with, surgery. Radiotherapy usually gives better preservation of function and in some cases gives better cosmetic results than does surgery. Plastic repair is seldom indicated following moderate radiotherapy. The *x*-ray and radium give essentially the same biological effect but differ primarily in the degree of their intensities. Radium is capable of providing an intense strong effect for local use which can be concentrated superficially by a plaque or subcutaneously by needles. When compared to radium, *x*-ray provides a more homogeneous, even irradiation of controlled penetration.

Radium therapy utilizing gamma rays has been classified as to how it is used, such as: (1) cavitary, used in a cavity of some sort; (2) interstitial, the placing of radon seeds into the tissues, this being advantageous as the dose can be calculated and there

is a prolonged action; (3) surface radium treatment by the use of a paste or other such media; (4) distance treatment which is advantageous in that there is a great penetration, high dosage may be given, and it may be administered daily.

Roentgen radiation is also classified as to how it is applied. There may be a direct application of perhaps 3,500 r at one sitting. However, this method is practical only in small superficial lesions. There may be fractionated, very low irradiation over large surfaces or there may be the type that is probably most used, mixed, a compromise between the first two types mentioned.

Doses of radiation depend upon a number of factors which certainly require a radiologist's knowledge. The type of mass is, however, of paramount importance in calculating dosage. Tumors are classified as: (1) radiosensitive, (2) radioresponsive and (3) radioresistant.

However, it is known that radiosensitive does not mean radiocurable and that radioresistant tumors on the other hand may sometimes be cured by the use of adequate irradiation.

It is gratifying that supervoltage even though having great internal effect does have less effect on the skin. Also, due to the depth of the dose and the fact that there is less attenuation of beam, it makes for a more homogeneous covering of the area to be subjected to the rays It permits simplification of technics by reducing the number of portals which are necessary in the process of crossfiring. However, the clinical results with supervoltage therapy have not been as much better than those using conventional deep therapy equipment as we would have desired.

Generally, x-ray therapy is indicated in. (1) tumors that for one reason or another cannot be surgically removed; (2) in those cases where preoperative irradiation is necessary to localize the mass where it can then be surgically removed, (3) where surgery is employed but for one reason or another all of the tumor cells are not removed, (4) those neoplasms in which the possibility of cure by radiation therapy is greater than by surgery, (5) when surgery is not indicated in advanced disease and there can be palliative relief obtained by this means.

Irradiation has a definite use in deep-seated cancers, but it must be handled properly or there will be a destruction of the intervening tissues also. The purpose of irradiation is to deliver to the cancer the most effective homogeneous dose produced by just enough energy to obtain the desired results.

Treatment with roentgen rays has been given best by using radiation therapy through multiple-fixed fields. This is very good

because the center or primary lesion is exposed to extensive homogeneous treatment, while each area of the skin tissue, due to the rotation, receives only a fraction of the entire dose.

It is advisable and essential to treat 5 mm. at least beyond the visible border of the lesion and use 7 to 10 erythema doses in three to 10 days depending on the size, type, etc., of the tumor. Small superficial lesions are treated by low voltage *x*-ray or radium plaque. The infiltrating forms of cancer are treated by intermediate or high voltage, lightly filtered *x*-ray. Interstitial radium may be used in conjunction with *x*-ray in the more malignant forms of cancer.

In cases where metastasis has occurred, irradiation may also be the treatment of choice. If the metastatic nodes are exposable, they are treated with the same technique as for the primary lesion. If the nodes are deep-seated, they are treated the same as any primary lesion.

Even though the case has been written down as "incurable", the physician does not necessarily have to resort to the writing of prescriptions for opiates. The object of radiation in advanced or incurable cancer is a palliative procedure only.

Radiation should be given for the relief of pain, thereby trying to prevent the excessive use of analgesic and hypnotic drugs. Pain is reduced by *x*-ray treatments by reducing the size of the tumor; thereby reducing the pressure which forms on the nerve endings. Radiation also causes recession of bone metastases. It is also used in this stage to prevent and treat pathological fractures—this again prevents a very severe type pain from this type of fracture. The headaches and neurological disturbances produced by cerebral metastases often yield to radiation, and, therefore, these symptoms can be prevented.

Many methods and technics are used for applying radiation therapy. In most cases teleradium, interstitial or surface irradiation is employed, the desired end in all cases being the destruction of the malignant cells. The first series of *x*-ray or radium treatment must be correctly applied if success is to be obtained because the lesion doesn't respond as well to subsequent irradiation of equal intensity. If necessary, great radiation must be given no matter what the damage to skin and surrounding tissues. The cancer must be destroyed even if some of the surrounding tissue is sacrificed or damaged in the effort

For carcinoma of the skin, from 4,000 to 6,000 roentgens are recommended in fractionated doses or single doses of 3,200 to 3,600 roentgens Kesmodel suggests 1,000 to 1,800 roentgens to

various areas as prophylactic radiation in breast cancer and a total of from 2,400 to 3,000 as preoperative irradiation.

Recommendations of Pfahler and Keefer are essentially the same, and an over-all dose of 7,200 roentgens to three portals is the suggestion of Marshall and Hare.

For enlarged nodes Merner and Stenstrom generally give from 1,000 to 2,000 roentgens, for cervical nodes 900 to each of three fields and a total dosage of 30 roentgens per minute for two or three doses as spray irradiation. However, it is generally agreed that a much higher dosage is necessary. 6,000 r delivered to the tumor in about five weeks will produce the optimum results. The factors for roentgen therapy vary from 90 to 200 kv, filters of copper, lead or aluminum varying from 0.25 to 2 mm., portals of about 15 cm. and skin target distances from 20 to 50 cm.

Cutler and Buschke state that the effect of irradiation on the neoplastic cell, as it is used therapeutically, is the devitalization of the cell. Intracellular changes are commonly seen histologically in irradiated tissues, consisting of nuclear alterations and changes in the protoplasm which alter the size and shape of cells. The clinical expression of the effects of irradiation is seen in the regression of the tumor.

That following the advent of *x*-ray therapy, there is a distinct increase in the survival period by as much as one or two years is stated by Merner and Stenstrom.

Pfahler and Keefer believe the operative results can be improved by preoperative and postoperative therapy.

It is generally accepted that irradiation inhibits local recurrence and persistence, relieves pain from bone metastases and is palliative in lymphatic spread of cancer. Some operators perform lymphadenectomy and believe it to be a valuable adjunct to radium and roentgen therapy.

Four weeks before operation, Taussig delivers by deep roentgen therapy from 1,000 to 1,500 roentgens, to the cervix in borderline cases of cancer, then two weeks postoperatively he implants 150 mg. of radium in gold capsules to give from 4,000 to 5,000 mg. hours and following this he gives an additional 2,000 to 2,500 roentgens by deep roentgen therapy. In uterine carcinoma, Ward's average initial dosage of radium has been from 2,400 to 4,200 milligram hours. Nearly 50 per cent of his cases, he states, have had more than one application, and many of his successful cases have had three or more irradiations.

The acme of radium applications is achieved only when a sufficient supply of radium salt or its emanation suitably screened is

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specimen before removal, and this can aid greatly in his diagnosis. Even though there is a very high percentage of correct diagnosis by this method and often a great deal of excessive surgery is avoided, there are many operators who have no faith in this procedure.

In the surgical removal of cancer, the surgeon must have a good understanding of the methods whereby the cancer spreads. The chief surgical method consists of the block dissection. This consists of the removal of the primary cancer and its regional lymph nodes in one block of tissue. The intervening tissue cannot be spared. If the cancer can be removed prior to its spread beyond these limits, the person can be cured. Block dissection is applied to cancer of the breast, colon and rectum, small intestines, peripheral parts of the lungs, unilateral involvement of the thyroid and some cases of squamous cell carcinoma of the skin and in melanoma malignum.

There are many for and against this prophylactic removal of the regional lymph nodes. The trouble lies in the fact that a definite diagnosis cannot be made clinically by physical examination. When the nodes are not palpable there is an involvement in 10 per cent of the cases. Even when nodes are palpable the error in the assessment of metastasis runs between 25 and 30 per cent.

A second surgical procedure consists of removal of the primary tumor and, at some later date, the removal of the regional lymph nodes. This is done by some surgeons when it is known that it is a highly malignant type cancer or when, after careful observation, the nodes are observed to become involved at a later date. This helps to avoid unnecessary removal of these nodes. Squamous cell carcinomas of the lips, buccal mucosa, gingivae and hard palate and also squamous cell carcinomas of the skin are treated by this method.

By experience, it has been found that some types of cancer are very slow growing and of a low type malignancy. Since the chance for metastasis is slight, the surgical procedure consists of the removal of the primary lesion only. Some basal cell carcinomas of the skin and some mixed cell tumors of the salivary glands in the parotid, intraoral or cervical region are in this group of cancers. Adamantinomas and fibrosarcomas are in this group. Neurosarcomas are also handled in this manner, but a good margin of tissue must be resected with them.

The fourth group consists of the desperation therapy whereby some of the important blood vessels are involved; such as, the aorta, portal vein, and superior mesenteric artery, or of both ureters

at hand at the moment of application. A combination of irradiation with operation may be devised that will be more effective.

From the general appearance of the growth, Ward is of the opinion that it can be determined whether the several stages of hyperemia, local sloughing, separation of slough, and healing process with final cicatrization and marked contraction, which represent the phenomena of irradiation of the cervix by radium, are progressing satisfactorily.

The most widely used method of treatment of cancer is surgery. Space in this chapter does not permit the complete discussion of surgery since the technics vary with the site, type and extensiveness of each lesion.

Early and sufficiently extensive surgical procedures are more often curative than other therapeutic measures. Once a definite diagnosis is made and surgical treatment has been decided upon, it should be employed as soon as possible. This treatment should be aimed toward the complete destruction or removal of the entire growth without trauma or the risk of disseminating the disease to other parts of the body.

In surgical treatment of cancer, there are many associated factors that have to be considered. The age of the majority of cancer patients is between fifty and seventy years, therefore, often found associated with cancer are cardiovascular diseases, pulmonary fibrosis, emphysema, poor kidneys and other degenerative disorders In cardiovascular conditions, study should be made of the blood pressures, electrocardiography, venous pressure, and kidney function tests. These tests will help greatly in determining the choice of anesthesia, whether the operation should be done, and most precautionary measures to be taken.

Weight loss of the patient should be considered also. It has been found that patients that have lost considerable weight usually indicate extensive metastasis, even though the tumor seems to be localized and the general condition is good Weight loss has a bearing on healing of wounds, blood volume, and anemia Anemia is often a usual thing with cancer It is necessary in the majority of the cases to give several transfusions before the operation to correct this deficiency and also during the operation to replace that which is lost at that time.

Many times today the diagnoses for internal lesions are made by the frozen section technic of biopsy This is done after the incision is made and the area has been reached The surgical pathologist in the large hospital has opportunity for making a good diagnosis by this method. He also has the opportunity of seeing the gross

for his own happiness. When it is necessary to do this radical surgery, he should try to restore the organ or organs or part to a condition that as nearly as possible performs its proper function. Often, there are many follow-up plastic operations and the construction of mechanical appliances which have to be done.

One important phase of treatment of cancer, which is given little attention in our vast amount of teaching literature is postoperative care following surgery. This treatment should begin with orders by the surgeon concerning the welfare of his patient during convalescence. These orders should include (1) maintenance of adequate airway, (2) control of hemorrhage, (3) diet and fluid balance, (4) sedation and (5) dressings, wound healing and prevention of complications.

The maintenance of airway applies particularly to operations in the regions of the nose and mouth. The patient should be placed on his abdomen or chest in order that fluid can escape from the mouth. Suction equipment should be kept at the bedside and the patient never left alone until fully reacted from anesthesia. Oxygen and carbon dioxide inhalations may be used to shorten the recovery time and to minimize possible pulmonary complications. The inhalations are given every fifteen or twenty minutes, or at the time blood pressures are checked. The proper ratio of this inhalation mixture is approximately 70 per cent oxygen to 30 per cent carbon dioxide. Patients with actual or suspected respiratory difficulty should be watched closely. Important signs or symptoms of an upper respiratory blockage are: (1) unexplained and increasing restlessness, (2) intercostal and suprasternal retraction with each inhalation, with occasional dilation of the alae nasi, (3) increased pulse rate, which means that the heart is being taxed, and (4) cyanosis, a late sign, which is usually followed by a drop in blood pressure and loss of consciousness. A tracheotomy should be performed before cyanosis occurs unless other measures such as adjusting the airway, suctioning the throat, or loosening bandages give relief.

The control of hemorrhage is another important factor in postoperative care, especially in the regions of the face and neck because of the extensive collateral circulation system. Shock, according to Harkins, is initiated by traumatic local fluid loss, either whole blood or plasma. The etiology of traumatic and hemorrhagic shock is basically the same. The symptoms of shock are similar to those of upper respiratory blockage. These include: (1) an ashy gray color, (2) cold, clammy skin, (3) fast but weak and irregular pulse, (4) progressive fall of blood pressure and (5)

or the bronchi. Deep radiation has not proved to be successful for these internal cancers. This operation consists of the local removal of the tumor or the tumor and the regional nodes. The percentage of survival is small, but it is better than condemning the patient to certain death without a chance of recovery. The hypernephromas are usually handled in this manner, because of their rapid and widespread metastasis. This last chance surgical procedure is used on the basal cell tumors that have invaded the antrum or orbit and do not respond to radiation.

Most cancers of the stomach are diagnosed too late for the utilization of surgery, also gall-bladder cancers have many inaccessible nodes, therefore, surgery here is highly unsuccessful. Cancer of the breast may be inoperable when the following conditions prevail: when it is massive, involving scattered nodules; when there is a swelling in the arm; when there is osseous or clavicular metastasis; when it develops during pregnancy or lactation; when there is skin ulceration; or when the axillary nodes become involved and fixed.

In many of the so-called incurable cancer cases there is a great deal of treatment that can be given the patient. Surgery in some of these cases consists of radical resection. There have been many cases treated similarly to a case treated and described by Cooper.

In this operation, the tail of the pancreas, the spleen, the left kidney, part of the descending colon and the involved portion of the abdominal wall were removed, but as yet there has been no metastasis or recurrence The great advancement in all surgery, x-ray therapy, and radium treatment has done much to reduce this incurable class of cancers. No previously untreated cancer should be classed as incurable unless a team of competent surgeons, radiologists, and pathologists have thoroughly and completely studied the case

A definite indication for surgical removal is always present if irradiation is a failure. In case of recurrence or if failure to control a carcinoma follows irradiation therapy, then it should not be continued if excision of the lesion is possible The average intelligent patient will choose radical surgery in a case such as this if the entire picture is explained to him Some operators feel that they have no right to withhold any form of treatment just because they feel it is exceptionally mutilating. If uncontrolled, in some cases the cancer will produce greater mutilation in its relentless progress. However, the surgeon must consider the patient and try to return him to a condition where he will be useful, at least

for his own happiness. When it is necessary to do this radical surgery, he should try to restore the organ or organs or part to a condition that as nearly as possible performs its proper function. Often, there are many follow-up plastic operations and the construction of mechanical appliances which have to be done.

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inefficient breathing. There are two aims in the treatment of shock. These are replacement of fluid loss and prevention of further loss of fluid. Whole blood or plasma can be used to replace the loss of fluid.

Postoperative diets are given by oral intake, tube feedings or intravenously as the occasion demands. Tube feeding is preferred to the intravenous method when the patient is unable to swallow. Glucose, as a food, serves two purposes: it prevents starvation ketosis and aids in protein metabolism. There are three factors that contribute to immediate postoperative hepatic glycogen deficiency. These are: glycogenolytic effect of certain anesthetics, inadequacy of oral food intake, and disease itself.

The usual postoperative order for the prevention of pain and comfort of the patient is one grain of codeine combined with ten grains of aspirin given every four to six hours. For sedation, 1½ grains of pentobarbital sodium may be given as necessary, within safe limits Codeine may be given hypodermically. This route of administration should be employed if the patient is nauseated. Morphine may be substituted for codeine if it is thought that the patient will suffer an unusual amount of pain.

Testosterone acetate and propionate have been found efficacious in mammary cancer in women.

Fels used 25 mg. of testosterone propionate every other day, Ulrich 10 mg. of crystallized testosterone acetate for 10 injections and 20 mg. for 6 injections, and Loeser gave up to 700 mg. of testosterone propionate.

Ulrich found that pain was alleviated or disappeared entirely, edema disappeared and the size of the tumor was decreased decidedly. Loeser found that this type therapy appeared to inhibit postoperative recurrences.

Adair states that testosterone may be employed on female patients with breast cancer at any age, while estrogen therapy must be strictly confined to patients of sixty years and older. The best results of testosterone therapy, he says, are obtained in cases having bone metastasis. However, Adair and Taylor caution that more research will be necessary before the value of endocrine therapy in the treatment of mammary cancer can be evaluated fully.

The use of estrogens in the treatment of carcinoma of the prostate has received considerable attention in the last few years

Baretz has reported using an average dose of stilbestrol of 1 to 2 mg. daily; later, if necessary, as much as 5 mg. daily may be given. Chute, Willetts and Gens gave intramuscular injections of

10 mg. of stilbestrol for five to ten days after orchidectomy and kept their patients on maintenance doses of 1 mg. orally 3 times a day for one or two months.

The results to be expected in over 90 per cent of cases are a gain in weight with an improvement in general condition and urinary symptoms; the prostate becomes softer; enlarged lymphatic edema disappears. The pain from osseous metastases may disappear. A raised acid phosphatase falls. It is also reported that this therapy prolongs life, shrinks the prostate, inhibits extensive malignant processes for varying periods, retards the disease and in rare cases, Scholl says, may be curative.

Herger and Sauer state that androgen control therapy, that is, castration with or without stilbestrol medication, has proved its value as a method to prolong life in far advanced or metastatic prostatic cancer and that it is the most effective palliative method in the treatment of patients with inoperable and rapidly progressing carcinoma of the prostate.

Radiophosphorus has been shown to have therapeutic value in leukemia, lymphosarcoma, polycythemia vera, myeloma, Hodgkin's disease and metastatic carcinoma. Radiophosphorus may be given orally or intravenously.

The doses vary with the condition treated but up to 20 millicuries have been given. Generally from 1 to 2 millicuries have been given per week for several weeks.

Isotopes other than radiophosphorus that have been used therapeutically are radioactive iodine, iron, sodium, potassium, chlorine, bromine, calcium, strontium, sulfur, carbon and hydrogen.

Results have been remission, depression of cell growth, a prolonged useful and comfortable life, palliation and partial to complete regression of the disease with freedom from recurrence.

At the present time, the only radio-elements with which significant positive results have been obtained, are radiophosphorus in polycythemia and leukemia, radioiodine in hyperthyroidism and carcinoma of the thyroid, and radiocalcium and radiostrontium in metastatic bone carcinoma.

Some chemical compounds, Medes points out, tend to concentrate within certain organs or tissues. Thus, radioactive iron is selectively taken up in the red cell, radioactive iodine by the thyroid and so on.

Low-Beer has employed radiophosphorous successfully in basal cell carcinomas, warts, various verrucas and in hemangiomas. The element was applied externally on blotting paper into which radiophosphorus was absorbed.

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with the resumption of biotherapy. Malisoff found endotoxin to exert a selective lytic effect on malignant tumors in mice.

Podophyllin, as K R endotoxin, is also not yet a proved effective therapeutic agent, but *in vitro* studies have shown it to be selectively damaging to tumor cells in concentrations of 0.08 to 20.0 mg. per liter.

In vivo studies with tumor-bearing mice confirm the selective tumor damaging effects of podophyllin. Podophyllotoxin, Ormsbee, Cornman and Berger remark, is not as effective as podophyllin in causing selective tumor damage.

There are numerous occasions on which the dentist is faced with the problem of removal of teeth in the presence of deep *x*-ray. When such work is done, whether it is at the time of treatment or some period of time thereafter, the operator must prepare himself for a long period of postoperative treatment, in some instances ending fatally as far as that portion of bone is concerned.

Numerous statements have been written concerning such problems, the more conservative, however, being that any tooth in the area of treatment which is faulty concerning its supporting tissues and offering a possibility of future extraction should be removed and the area allowed to heal before deep *x*-ray therapy is administered. Those adhering to the so-called radical, state that all teeth in the area of treatment regardless of condition should be removed before treatment is begun.

In all cases it would best be the policy of the dentist to refuse to extract teeth for any patient who has undergone deep *x*-ray therapy without first consulting with the radiologist who has administered the application. In this manner, much grief due to these causes can be eliminated.

It should be understood that the theory behind deep *x*-ray therapy for the cure of cancer simply stated is that the new cells making up the cancer formation are a bit more tender than the older or normal cells of the body and are more vulnerable to the *x*-ray However, on administration of the *x*-ray, the older cells or normal cells must undergo a certain amount of weakening punishment. In doing so, they lose much of their recuperative or healing power. If surgical procedures are then carried on in these weakened areas it must then be realized that healing will be slow or in some cases absent, depending upon the amount of deep *x*-ray given at the time of treatment. Then we must understand that irradiation is injurious to all tissues, normal as well as pathologic, but much less so in the former than in the latter. It may then be readily recognized that this is the basis of deep *x*-ray

Hodgkin's disease, lymphosarcoma, leukemia, polycythemia rubra and vera, multiple myeloma, sympathoblastoma and other selected allied disorders have responded to therapy with nitrogen mustard. The usual bi-daily or daily dose is 0.1 mg. per kilogram of body weight administered intravenously for 1 to 6 doses, generally for 4 doses. Erf gives 5 to 10 mg. for 4 doses. Subsequent therapy may be given after an interval of several weeks. The solution should be injected within five minutes of its preparation.

Temporary regression, partial to complete remission and general palliative results have been reported from treatment with this agent. The effects are similar to those obtained with roentgen therapy.

Salutary results have been obtained, particularly in Hodgkin's disease, lymphosarcoma and chronic leukemia. Indeed, in the first disorder dramatic improvement has been observed

Nitrogen mustard apparently acts by releasing hydrochloric acid intracellularly.

Stilbamidine or urethane has been used in leukemia, metastatic tumors, carcinoma, myeloma, prostatic cancer and related disorders Stilbamidine, ethyl carbamate, is administered orally, intravenously or intramuscularly daily or every other day in doses of 0 5 to 2 gm. Total dosages reported vary from 5 to 221 gm given during periods of up to fifty-four days.

Following therapy, a fall in leukocytes, favorable influence on anemia, decrease in the size of the lymph nodes and the spleen, reduction in the leukemic foci of certain organs, arrest and a check in myeloma, relief of pain, general improvement, rise in hemoglobin and, in prostatic cancer, there was considerable regression, decrease in acid phosphatase and decrease in the size of the tumor. A diet low in animal protein has been used. Snapper and Schneid state that large basophilic granules appear in the cytoplasm which show a tendency to become confluent. One of the main constituents of these inclusions consists of ribose nucleic acid.

Although still in the experimental stage K R endotoxin deserves mention. This endotoxin was used by Klyueva in 19 patients with cancer in doses of 30 to 35 K R units (1 unit is the lyzed produce of 1,000,000 Trypanosoma cruzi organisms) per injection for 45 to 50 injections.

The rapidity of tumor disintegration, Klyueva reports, varied with the dosage of K R. Tumor regression increased if the doses were increased, decreased with smaller dosage, and disappeared

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therapy. Knowing then that the amount of injury depends upon the amount of therapy delivered, it is wise that the one employing these rays hold them as closely as possible to the exact area involved and not allow them to stray over adjacent or associated areas. Modern methods of delivery of radium and x-rays to the patient have eliminated much unnecessary devitalization of otherwise normal tissue.

In summary, it must be stated here that the primary purpose of this brief section is to warn the dentist to be insistent on holding consultation with the radiologist before teeth are extracted for patients having undergone such treatments as those mentioned above. Much grief and many postoperative visits might be eliminated in this manner.

CONCLUSION

Though cancer has been recognized as a dreaded and serious killer for numerous generations and millions of man hours have been utilized in this concentrated study bringing about many aids and helpful procedures, yet conclusive etiology and treatment remain hidden.

Within the past few years the public has been educated concerning the disease and thus has become more cancer conscious. This in turn will bring about more cases of early diagnosis, hence more cures and lives prolonged

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12

Radiation Therapy in the Treatment of Cancer

BY DAVID S. CARROLL, M.D.

INTRODUCTION

SHORTLY after the discovery of x-ray by Wilhelm Conrad Roentgen in 1895, and after the isolation of radium by Marie and Pierre Curie in 1898, it was noted that these powerful electromagnetic radiations (x-rays and gamma rays) had an injurious effect on living tissue, and that if given in sufficient dosage would cause death of living cells. A few months later it was discovered that these radiations injured some types of tissues easier than others, and that in particular many types of malignant tissues were more sensitive to the radiations than were normal tissues.

Since those early beginnings in radiation therapy a scant half century ago, marvelous strides have been made in equipment, (Fig. 1) in the knowledge of the physics of these radiations, and in the knowledge of their biological effects. Today, radiation therapy has grown of age and can assume an illustrious position in medicine in the treatment of cancer. There are only two major weapons in the fight to cure cancer. One is surgery; the other is radiation therapy. At the present time it would be very difficult to say that one weapon is more important than the other. Garland recently analyzed the roles of surgery and radiology in the treatment of cancer. He estimated that of 100 cases of cancer, 32 would be best treated by radical surgery, 13 would be best treated by a combination of surgery and irradiation, 32 should be treated by radical irradiation, 9 should be treated by palliative surgery, 8 by palliative irradiation, and 7 could be offered only medical therapy.

The roles of surgery and radiation therapy in the treatment of cancer are complimentary and not competitive. The location and type of tumor determine which weapon can be used to the best advantage. If cancer is to be cured it must be either totally removed by surgery or completely destroyed by irradiation. Although

irradiation has not proved to be the sure and easy way to the cure of cancer that was first hoped for, and although the treatment of cancer today falls far short of what we would desire, still it is far from a hopeless task. The cure rate in early accessible cancer is quite high (from 65 to 95 per cent of treated cases, depending upon the location and type of tumor.) Many patients, who would most



FIG. 1. High voltage x-ray therapy unit operating up to 250 kv. (Courtesy General Electric X-ray Corp.)

certainly have died of their disease a few years ago, are today being given a fair hope of permanent cure.

PROPERTIES OF ELECTROMAGNETIC RADIATION

The radiant energy emitted by an *x*-ray tube and gamma rays emitted by radium are identical rays and differ only in their origin. As a matter of fact, all of the electromagnetic radiations (radio waves, ultraviolet, visible light, infra-red, *x*-ray, and gamma rays) are quite similar and differ from each other only in their wave length and frequency (Fig. 2). All electromagnetic radiations travel with the speed of light: that is, 186,000 miles per second. The wave length of any electromagnetic radiation is equal to the speed of light divided by the frequency or number of cycles per second. Radio waves have a rather long wave length, the wave length being measured in terms of many meters On the other hand, the wave length of *x*-ray and gamma rays is quite short, being measured in either Angstrom units or in *x* units. (An Angstrom unit is one one-hundred-millionth cm., and an *x* unit is one one-hundred-billionth cm.) The energy of an individual unit or quantum of electromagnetic radiation can be computed by the formula: energy is equal to Planck's constant times the frequency. Since the frequency is equal to the speed of light divided by the wave length, those electromagnetic radiations with a long wave length have a low frequency, and those electromagnetic radiations with a short wave length have a high frequency. Therefore, those electromagnetic radiations with a long wave length have a low energy per quantum of radiation, and those electromagnetic radiations with a very short wave length (such as *x*-ray or gamma rays) have a very high energy per quantum of radiation. This, of course, accounts for the properties which are characteristic of *x*-rays and gamma rays, characteristics which the other electromagnetic radiations do not possess.

The properties of *x*-rays and gamma rays may be listed as follows:

1. The photographic effect: *x*-rays and gamma rays have the property of precipitating metallic silver in a photographic emulsion just like visible light.

2. The fluorescent effect: *x* and gamma radiation has the property of causing fluorescing materials to absorb the radiation and emit visible light.

3. The penetrating effect: *x* and gamma radiation has the property of penetrating through materials which may be opaque to visible light.

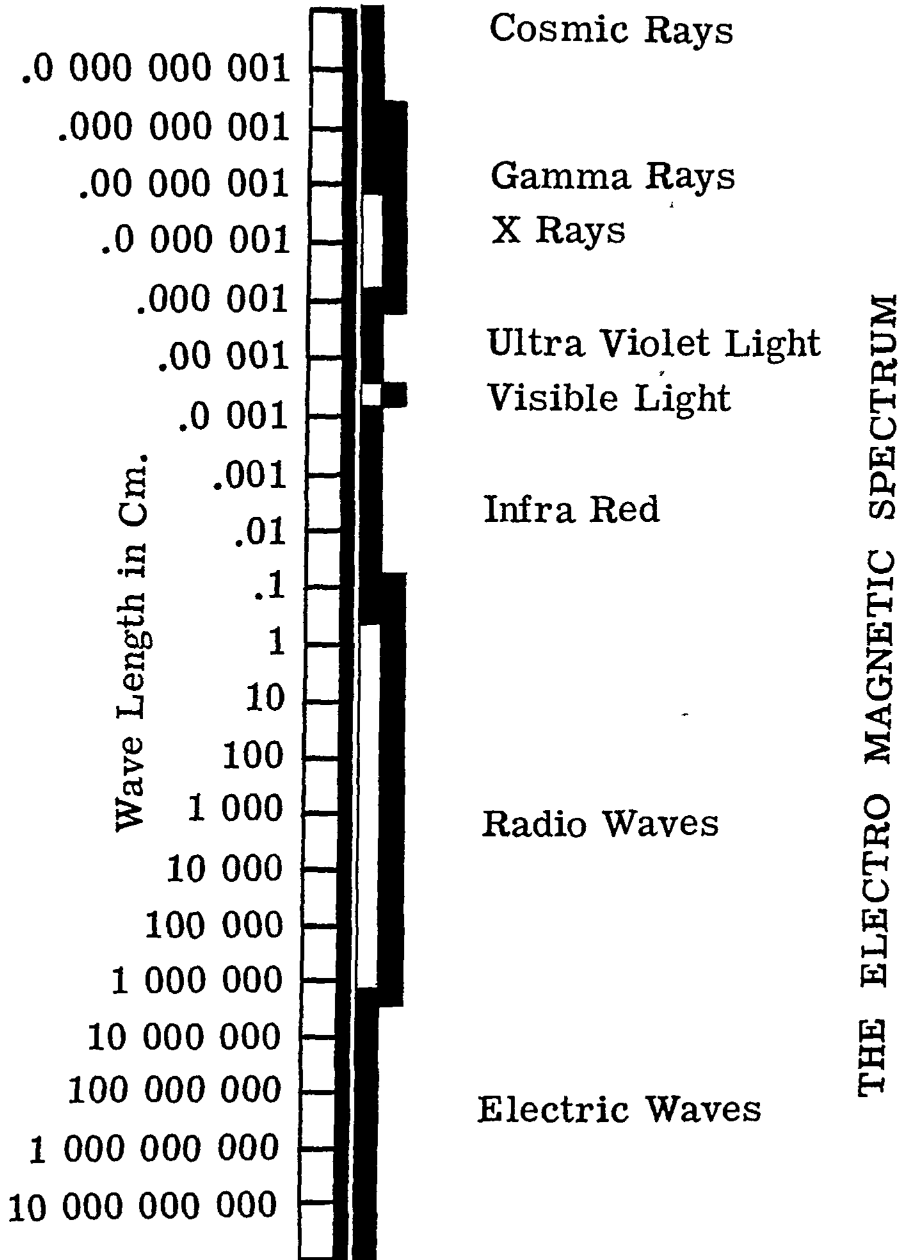


FIG 2 Electromagnetic Spectrum

Type of Radiation	*Wave Length Range*	*Frequency Range*
Electric waves	? to 3,000,000 cm.	Since all electromagnetic radiations travel with the same speed, *i e*, the speed of light, their approximate frequency in cycles per second is equal to 30,000,000,000 divided by the wave length in centimeters, 3 × 10^{10} cm per sec being the approximate speed of light.
Radio waves	3,500,000 cm. to 0 3 cm	
Infra red	0 3 cm to 0 000,076 cm	
Visible light	0 000,076 cm. to 0 000,04 cm	
Ultraviolet	0 000,04 cm to 0 000,000,01 cm	
X-rays	0 000,001 cm to 0 000,000,000,1 cm	
Gamma rays	0.000,000,001 cm to 0 000,000,000.001 cm	
Cosmic rays	0.000,000,000,01 cm to ?	

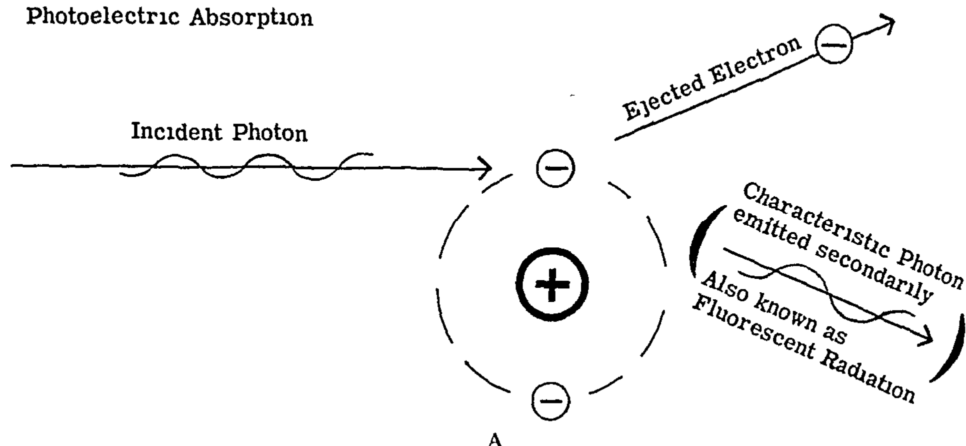
4. The ionization effect: x and gamma rays cause ionization of the atoms of any medium through which the rays pass.

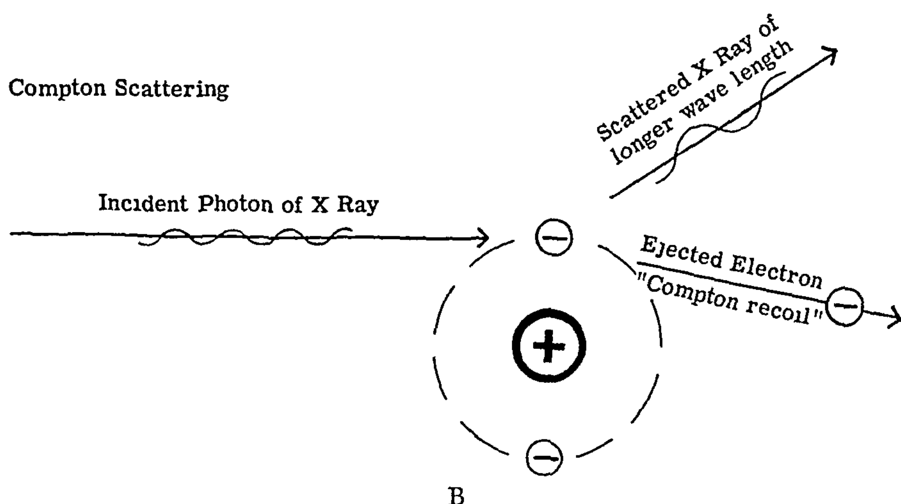
5. Chemical and dehydrating effects: short wave length electromagnetic radiation has the power to cause many different chemical reactions to occur.

6. Biological effect: x and gamma rays have the ability to damage or kill any living cell.

INTERACTION OF *X*-RAY AND MATTER

In order to understand how x-ray accomplishes its various effects, including particularly its biological effect, it is necessary to understand something about just what happens when x-rays interact with matter. As an x-ray photon (a photon is an individual unit or quantum of radiation) goes through the human body or any other matter, any of four things may happen to that photon. (1) It may pass through the body and emerge from the other side of the body unaltered in either wave length or direction. This photon which has not suffered any collision has not produced any reaction in the body since it has not delivered any of its energy to the cells of the body (2) A photon may undergo a photo-electric collision A photo-electric collision is a collision between a photon of x-ray and an electron in an orbit of an atom, the photon of electromagnetic radiation knocking the electron out of its atomic orbit and giving up all of its energy to the removal of the electron from its orbit and to the acceleration of that electron. Since the photon of x-ray has delivered all of its energy to the electron, it ceases to exist. The ejected electron, called a photo-electron, now has a considerable velocity, and this electron undergoes many collisions with other electrons along its path, knocking many other electrons out of their orbits also. Since ionization consists merely in the removal of an electron from an orbit of an atom, a series of ion pairs is formed along the path of the photo-electron. This ionization continues until the electron has given up all of its kinetic energy to the formation of ion pairs. (3) A photon may undergo a Compton collision. A Compton collision is again a collision between a photon of high energy electromagnetic radiation and an orbital electron and differs from a photo-electric collision in that only a portion of the energy of the photon is spent in removing the electron from its orbit and imparting to it a rather high kinetic energy. The ejected electron, called a Compton electron, behaves just like the photo-electron did, producing along its path a series of ion pairs. However, since the photon did not give up all





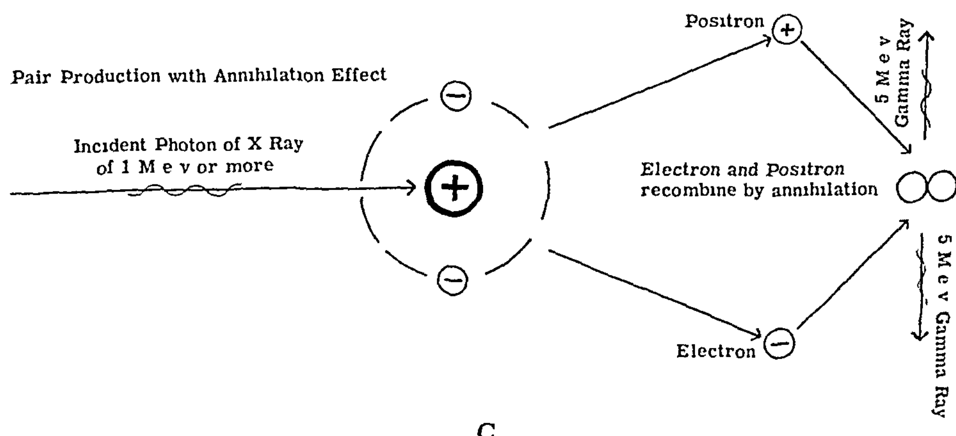


Fig. 3. Methods of absorption and scattering of x-ray A. Photoelectric collision B Compton collision C Pair formation. (Holmes and Schulz, Therapeutic Radiology.)

of its energy in the collision, it continues on, although altered in direction and altered in wave length. The wave length is now considerably longer, the energy having been reduced. The photoelectric collision is the predominant type of collision between photons of *x*-ray and matter when the kilovoltage producing the *x*-ray is quite low. *X*-ray produced at higher kilovoltages interacts with matter with a predominance of Compton collisions. (4) If over a million volts is used in producing the *x*-ray or if the gamma radiation in question has an energy of over 1 mev, the interaction of radiation and matter may result in pair formation. Pair formation is of little interest in conventional clinical radiation therapy, since it does not occur at less than a million electron volts energy. It simply consists of the formation of an electron and a positron (a positively charged electron) when a very high energy photon is in the neighborhood of an atomic nucleus. Both the electron and the positron behave like any electron with considerable velocity and produce ion pairs along their paths. When the positron has given up its kinetic energy, it joins with an electron and both disappear, with the formation of two photons of 0.51 mev energy each, this being known as annihilation radiation

The result of these various types of interaction of *x* or gamma radiation and matter is the transfer of energy from the radiation to the matter in the form of ionization (Fig. 3).

X-RAY QUANTITY

In order to use *x*-radiation intelligently, we must have some unit of quantity whereby we can measure the amount of radiation present, and thereby express our dosage in terms of units of quantity. The unit of quantity of *x*-ray is based on the ionization property of radiation, and is the roentgen. The *roentgen* is that amount of *x* or gamma radiation such that the associated corpuscular emission per 0.001293 gm. of air produces in air ions carrying one electrostatic unit of electricity of either sign. This is the only acceptable unit of quantity of *x* or gamma radiation. The unit of intensity of *x*-ray is roentgens per minute.

The intensity of radiation can be altered in several different ways. The intensity varies directly with the milliamperage, and therefore one could double the intensity of radiation by doubling the milliamperage or tube current. The intensity of radiation varies directly with approximately the square of the kilovoltage. *X*-ray intensity varies with the distance in the same manner that any electromagnetic radiation does; that is, the intensity is inversely propor-

tional to the square of the distance. Intensity varies with the material and thickness of filtration used, and any increase in filtration will result in a decrease in intensity. Finally *x*-ray intensity varies directly with the atomic number of the material used in the target of the *x*-ray tube.

Intensity of irradiation is measured with an ionization chamber or roentgen meter; and the tube output at the various combinations of milliamperage, kilovoltage, filtration, and distance as used in clinical therapy must be measured periodically as a part of the standard operating procedure of the radiation therapy department.

X-RAY QUALITY

Not only is it necessary to express *x*-ray units of quantity, it is also necessary to have units by which we can measure *x*-ray quality. The shorter the wave length of the *x*-ray, the more deeply it will penetrate into the body. In other words, if the *x*-ray wave length is short the dose at a depth within the body would be greater than if the *x*-ray wave length were longer. The amount of radiation received by the tumor is what determines the effect that the *x*-ray has upon the tumor, and, therefore, in order to be able to give the correct dose to a tumor situated at a depth some distance beneath the surface, it becomes necessary to know the *x*-ray quality as well as the quantity

If the *x*-ray beam were a monochromatic beam, the correct way to express *x*-ray quality would be simply to express the wave length of the *x*-ray. But *x*-ray is not a monochromatic beam. On the contrary, it possesses many different wave lengths. *X*-ray is produced by directing a stream of very rapidly moving electrons across an *x*-ray tube to a target. When these electrons strike this target their kinetic energy is changed to *x*-ray and heat. The kilovoltage applied to the *x*-ray tube is what determines the speed of the moving electrons. The shortest wave length of *x*-ray produced will be produced by the most rapidly moving electron which is stopped on one collision, thereby giving up all of its energy to the production of a single photon of *x*-ray. This shortest wave length in Angstrom units is equal to 12.42 divided by the peak kilovoltage

Not all of the *x*-ray is produced by the peak or highest voltage applied to the tube, however. At other times during the voltage cycle, the voltage is less, and therefore the wave lengths produced by these voltages are correspondingly longer. Even more important than this is the fact that most electrons do not give up all

their kinetic energy with one collision, but may undergo several different collisions with the atoms making up the target before finally coming to a stop. Therefore, one has all wave lengths of x-ray represented in the x-ray beam – from the shortest possible, as computed by the formula $\lambda = \frac{12.42}{Kv}$, to the longest which can escape from the tube. Thus, a continuous spectrum of x-ray wave length is produced.

Superimposed upon this continuous spectrum are rather sharply limited high intensity wave lengths, which may be termed characteristic radiation. These wave lengths are produced when inner orbital electrons of the target atoms are removed by the cathode ray and subsequently replaced by other electrons. The wave length of characteristic radiation depends upon the orbit involved and upon the atomic number of the target material. The higher the atomic number of the atom involved, the shorter the wave length So we can see that with such a complex spectrum, it becomes impossible to designate x-ray quality simply by wave length.

It has already been stated that the shorter the effective wave length of an x-ray beam, the more it will penetrate through matter. It follows then that the thickness of some metallic absorber necessary to reduce the incident intensity of the radiation to 50 per cent would be an expression of the quality of the x-ray beam. This is the generally accepted method of measuring x-ray quality and is known as the half-value layer. The shorter the effective wave length of the x-ray beam, the greater the half-value layer would be. Low voltage therapy (80 to 140 kilovolts) will produce an x-ray beam of such wave length that it is expedient to express the quality in terms of the half-value layer in aluminum. The conventional high voltage deep x-ray therapy units (140 to 400 kilovolts) produce an x-ray beam of such effective wave length that it is convenient to express the quality in terms of the half-value layer in copper.

There are two principal methods by which we alter x-ray quality. We can increase the half-value layer, reducing the effective wave length and making the x-ray more penetrating, either by increasing the kilovoltage or by increasing the amount of filtration. These two methods work in opposite directions. For example, if we increase the kilovoltage, we add short wave lengths to the polychromatic beam, thus making the effective wave length shorter. The intensity of the ray is, of course, increased (Fig. 4). On the other hand, if we increase the amount of filtration used, we absorb the longer wave lengths from the polychromatic beam to a greater extent than

the shorter wave lengths, thus again decreasing the effective wave length. This, of course, results in a reduction in the intensity of the beam (Fig. 5).

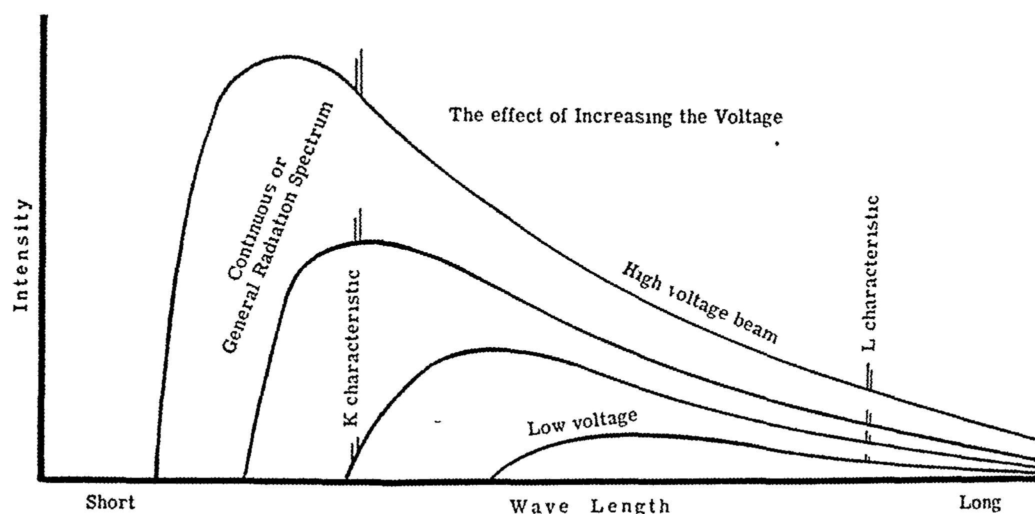


Fig. 4. *X*-ray spectra produced at various voltages. The effect of increasing the voltage is (1) to increase the total amount of radiation; (2) to shift the point of maximum intensity toward the short end of the spectrum, (3) to shift the minimum wave length toward the short end of the spectrum, and (4) to make the average wave length of the beam shorter. (Holmes and Schulz, Therapeutic Radiology)

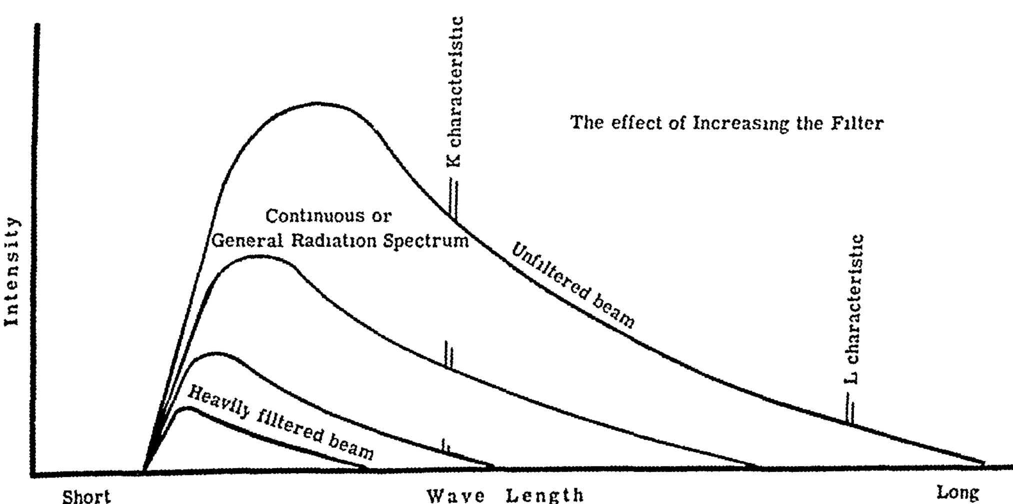


Fig. 5. *X*-ray spectra using different filters. The effect of increasing the filter is (1) to decrease the total amount of radiation, (2) to shift the point of maximum intensity toward the short end of the spectrum; and (3) to make the average wave length of the beam shorter. The minimum wave length is not changed. (*Holmes and Schulz, Therapeutic Radiology.*)

X-RAY DOSAGE

Dosage must be expressed as the number of roentgens given in air, the number of roentgens given to the skin, and the number of roentgens given to the tumor. Because of the interaction of radiation and matter with the absorption of the radiation by that matter and the production of secondary or scattered radiation, the three expressions of dosage are of necessity different. Secondary radiation, scattered in a backwards direction, is added to the dosage in air to make the skin dose greater than the air dose. If the tumor is situated beneath the surface of the skin, some of the radiation is absorbed between the skin and the tumor, so that the tumor dose is less than the air dose as a rule.

The air dose has little clinical significance. It is expressed only because it makes the administration of the therapy convenient in that we are able to compute the length of time the machine must be left on in order to give the required dose.

On the other hand, the skin dose is of marked clinical significance. The skin dose and the time of administration are what determine the skin reaction. The tumor dose is of still more clinical significance, because it is the tumor dose and the over-all time of administration that determine the effect of the radiation on the tumor.

Expressing the skin dose as a percentage of the air dose (that is, the number of roentgens given to the skin per 100 roentgens in air), we can analyze the various factors which influence the skin dose. First of all, the quality of the radiation influences the percentage skin dose. Using a quality of 1.0 mm. of copper half-value and a 15 × 15 cm. skin port, the skin dose would be 144 per cent. On the other hand, if we change to a half-value layer of 2.0 mm. of copper, the skin dose would be 132 per cent. In general we can say that as the quality increases above a half-value layer of 0.5 mm. of copper (approximately 140 Kv and ¼ mm. of copper filter), the percentage dose is decreased. However, as the quality is decreased below 0.5 mm. of copper half-value, the percentage skin dose is also decreased. Therefore, the maximum percentage skin dose is encountered with a half-value layer of approximately 0.5 mm. of copper.

The second principal factor which alters the percentage skin dose is the size of the port. For example, if we use a quality of 1.0 mm. of copper half-value layer and a 20 sq. cm. skin port, the percentage skin dose would be 122 per cent. However, if we change to a skin port of 400 sq. cm., the percentage skin dose would be

149 per cent. The percentage skin dose is thus increased by increasing the area of the skin port.

The percentage skin dose is not changed by changing the target-skin distance.

The tumor dose or depth dose is changed by three principal varying factors. Again, we shall express the depth dose as a percentage of the air dose—that is, the number of roentgens at a depth per 100 roentgens in air. An increase in quality of the *x*-ray beam will increase the percentage depth dose. For example, using a port of 100 sq. cm. and a target-skin distance of 50 cm., the depth dose 10 cm. beneath the surface would be 41 per cent using a half-value layer of 1.0 mm. of copper. Using the same factors except for changing the quality to 2.0 mm. of copper half-value layer, the percentage depth dose would be 43r at 10 cm beneath the surface.

Secondly, the percentage depth dose is increased by increasing the size of the skin port. For example, using a half-value layer of 1.0 mm. of copper at 50 cm. target-skin distance, the depth dose at 10 cm. would be 24 per cent if the port were 20 sq. cm. in size. On the other hand, if the port were increased to 400 sq. cm. in size, the depth dose would be 61 per cent.

Finally, the percentage depth dose is increased by increasing the target-skin distance. For example, using a half-value layer of 1.0 mm. of copper and 100 sq. cm. skin port, the depth dose at 10 cm. beneath the skin would be 38 per cent if the target-skin distance were 40 cm. If we change the target-skin distance to 80 cm, the percentage depth dose would be increased to 46 per cent.

Standard depth dose tables for varying qualities of radiation, various distances, and various size ports are readily available in the radiological literature.

BIOLOGICAL EFFECTS OF IONIZING RADIATION

While it is necessary to understand the physical principles underlying treatment of cancer by ionizing radiations, it is just as necessary to understand something about the fundamental biology of ionizing radiations. The effects of ionizing radiations on living cells are qualitatively the same regardless of whether the radiation used is some type of electromagnetic radiation, such as *x*-ray or gamma rays, or whether it is some type of corpuscular radiation, such as alpha, beta, neutron, or proton rays. Also there is no difference in the qualitative effect of these radiations regardless of whether

the radiation is delivered from within the body or from an external source outside the body.

Although the cell is the fundamental unit of living matter, it represents a very complex physical system since each individual living cell contains several billion molecules in active motion. Also, it is just as complex a structure chemically, since it is composed of many different chemicals including water, fats, carbohydrates, proteins, various minerals, and enzymes, many of which are in a very active and very delicate chemical equilibrum. Although we know that the first event in the production of irradiation effect is the formation of a group of ion pairs within the living cell, there is very little certain knowledge available as to the next occurrence in the chain of events leading to cell damage or death. Certainly, an important series of events is chemical in nature, leading to the formation of toxic substances. After the irradiation has produced the ion pairs within the living cell, there is a latent period before the effects of the radiation on the morphology and physiology become apparent.

The morphological changes in the cell include (1) pyknosis of the cell nucleus, (2) karyorrhexis, that is, the disintegration of the cell nucleus into fragments which are distributed in the cytoplasm, and (3) liquefaction of the cell mass. Functionally, the cells may show restricted or suppressed motility, suppressed reproductive power, restricted growth, altered metabolism, increased permeability, and restriction of some of the specific cell functions, such as glandular secretions. The vital energies of the cells and tissues are exhausted in a comparatively short period of time, the radiation impairing the ability of the cells to maintain metabolic equilibrium.

RADIOSENSITIVITY OF NORMAL TISSUES

Although ionizing radiations can cause the death of any living cell if given in sufficient dosage, there is a wide variation in the radiosensitivity of various cells and tissues. Radiosensitivity may be defined as the dose necessary to bring about a lethal effect. However, when studying the lethal effect of radiation on living cells, it is impossible to say that above a certain dose all of the cells are killed and that below that certain dose none of the cells are killed. On the contrary, if we plot the survival of a group of living cells against the dose of ionizing radiation employed, we find that as the dose increases there is a slow increase in the small percentage of cells killed. Then as the dose increases further, the per-

centage of cells killed increases rather rapidly. This continues up to a point beyond which a further increase in dose produces very little additional lethal effect. In other words, the survival curve is a sigmoid type curve. Probably the best expression of radiosensitivity, therefore, is an expression of the dose that results in 50 per cent lethal effect (Fig. 6).

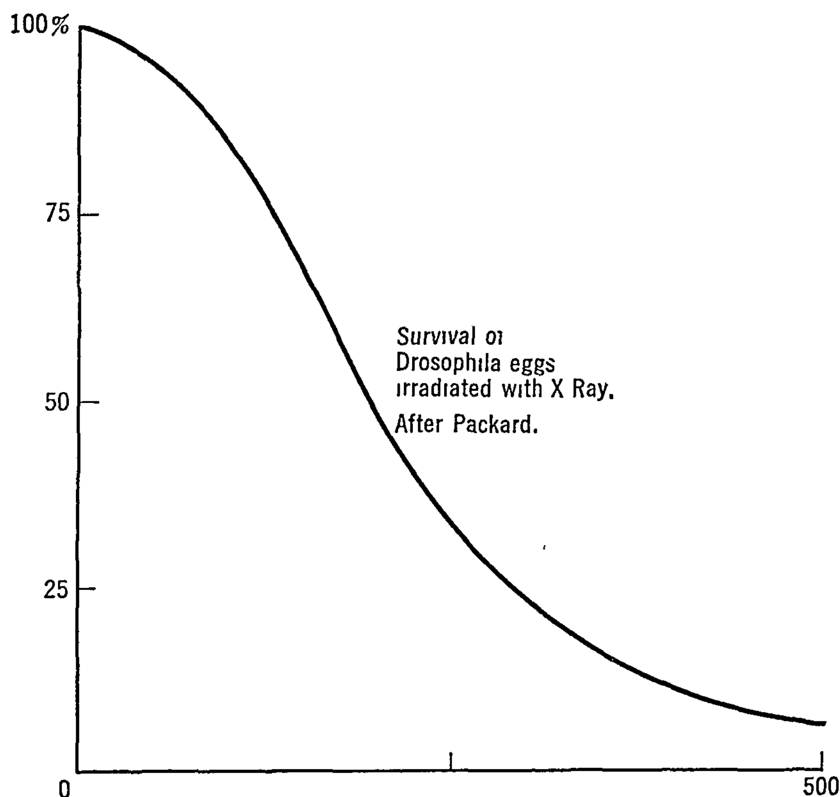


FIG. 6 This chart shows that all individuals in a given cell population are not affected in the same degree for any given amount of x-ray If they were there would be a 100 per cent survival up to a certain dose beyond which there would be no survivors

The different types of tissues making up the human body show a considerable difference in radiosensitivity. In order of diminishing sensitivity, the various tissues making up the body can be listed as follows:

1. Lymphocytes
2. Granulocytes
3. Epithelial cells
   (*a*) basal cells of secretory glands
   (*b*) basal cells of testis and ovary
   (*c*) basal cells of skin and gastro-intestinal tract
   (*d*) alveolar cells of the lungs and bile ducts
   (*e*) tubules of the kidneys

4. Endothelial cells
5. Connective tissue cells
6. Muscle cells
7. Bone cells
8. Nerve cells

RADIOSENSITIVITY OF MALIGNANT TUMORS

In 1906 two French scientists, Bergonie and Tribondeau, gave a simple law of radiosensitivity. It states, "The radiosensitivity of a cell is proportional to its reproductive capacity and inversely proportional to its degree of differentiation". Since malignant tumors show an excessive reproductive capacity and since they lose the morphologic and biologic differentiation of the parent, one would expect malignant tumors to be more sensitive to radiation than normal tissue. The increased radiosensitivity of malignant as compared to normal tissues forms the basis for the radiation therapy of cancer.

The law of Bergonie and Tribondeau, however, is entirely inadequate to explain all the variations in radiosensitivity noticed among the different tumors, and it is well at this point to consider the various factors which influence the radiosensitivity of malignant tumors. First of all, the tissue from which the tumor originated determines the sensitivity of the tumor to a great extent. For example, a lymphosarcoma is much more sensitive than is a fibrosarcoma because the parent cell of the lymphosarcoma, the lymphocyte, is much more radiosensitive than is the parent tissue of the fibrosarcoma, the fibrous connective tissue. Secondly, the less differentiated the tumor is (that is, the more atypical the cells making up the tumor are, both in morphology and in physiology), the more radiosensitive the tumor is. The size of the tumor influences the sensitivity, and, in general, we can say that the smaller the tumor, the more radiosensitive it is. The site of the tumor also influences the radiosensitivity, and a squamous cell carcinoma of the esophagus does not necessarily show the same radiosensitivity as a squamous cell carcinoma of the lip. Furthermore, such things as old age, poor general health, poor circulation, and anemia all decrease radiosensitivity of the tumor. Coexistent infection will decrease radiosensitivity, and therefore all infection should be cleared up, if possible, before intensive radiation therapy is started. Finally, previous treatment alters the radiosensitivity to a very considerable extent, and it is possible that a very radiosensitive tumor may be rendered radioresistant as a result of previous radia-

tion therapy. This, in part, explains the useful axiom that one has only one chance to cure cancer by radiation therapy.

One can divide the malignant tumors into three main categories, the first category being those which are radiosensitive, the second being those which show only limited sensitivity, and the third category being those which are radioresistant. Among the radiosensitive tumors we find such neoplasms as lymphosarcoma, lymphoepithelioma, Hodgkin's disease, seminoma, Wilms' tumor, and Ewing's tumor. Among the tumors of limited radiosensitivity we find such tumors as squamous cell carcinoma, basal cell carcinoma, and many of the adenocarcinomas. Among radioresistant tumors we find such tumors as osteogenic sarcoma, malignant melanoma, and fibrosarcoma.

CLINICAL APPLICATION OF *X*-RAY THERAPY

If radiation therapy for a malignant tumor is to be successful in eradicating the disease, it is oftentimes necessary to give a dose which will approach very closely the tolerance for normal tissues. In most cases, we find it most helpful to make use of the difference in the recovery rate for normal tissue and malignant tumors by fractionating the therapy over a considerable period of time. Instead of giving the entire dose in one treatment, the dose is administered in several fractions, each of which is rather small as compared to the total dose. Normal tissue has more ability to recover from such repeated small doses than does malignant neoplastic tissue, and by taking advantage of this differential recovery rate, we can produce a lethal effect in the malignant tumor with less danger and less reaction in the normal tissue.

Depending upon the size, location, and type of malignancy, therapy is usually fractionated over a period of two to six weeks.

In order to achieve success in the treatment of cancer by radiation therapy, it is most essential that the course of therapy be planned with meticulous care. First of all, it is necessary to know the exact location and limits of the primary lesion, and of course it is necessary to know the histologic type and grade of tumor. One must carefully search for regional lymph node metastases, and a careful search for distant metastases by means of physical examination and radiographic examinations is essential. The type of tumor, its location and extent, are what determine the type of radiation therapy to use; and, of course, the presence of regional or distant metastases influences the type of treatment to a great degree. When these various factors have

been determined, one can then decide upon the dose of radiation therapy to employ and the time over which the dose should be fractionated.

As has been stated previously, malignant tumors can be divided into three main groups: the radiosensitive tumors, the tumors of limited sensitivity, and the radioresistant tumors. In the treatment of the radiosensitive tumors, such as lymphosarcoma, it is necessary to use rather large ports and cover about 5 cm. of normal tissue beyond the apparent limits of the tumor. Also, in many of these tumors, it is well to give irradiation to the regional lymph node areas. This is particularly true in such tumors as lymphosarcoma of the nasopharynx or tonsil, in which case it is wise to irradiate the cervical node areas on both sides. Using such large ports, it is impossible to give an extremely high dose of radiation, and the tumor dose usually planned is about 2000 to 4000 roentgens in about three or four weeks' time. Such a procedure gives an excellent prognosis for permanent sterilization of the tumor within the area treated. Failures of treatment are usually due to the appearance of the tumor in distant parts of the body and not due to reappearance of the tumor within the treatment zone.

The type of radiation therapy given for tumors of limited sensitivity, such as squamous cell carcinoma, is entirely different. In the treatment of tumors of limited sensitivity it is wise to make the ports as small as possible, covering not more than 1 or 2 cm. of normal tissue about the tumor. Multiple ports are usually necessary, and the treatment is carried to a very high dose. A very satisfactory tumor dose to use would be about 6000 roentgens in a period of four or five weeks.

When one is dealing with a radioresistant tumor, however, a different approach must be used. One cannot hope to cure radioresistant tumors by radiation therapy since the dose necessary for the destruction of these tumors is greater than that which would destroy the surrounding normal tissues. Therefore, radioresistant tumors should be treated by surgery if possible. If surgery is not possible, one should give a growth restraint type dose in the hope of reducing the size of the tumor, relieving pain, and restraining the activity of the tumor in so far as growth is concerned. The dose would be of the order of 2000 to 2500 roentgens in three or four weeks' time.

In the planning of radiation therapy, not only must we consider the tumor dose, we must also consider the dose of radiation that the normal structures receive. For example, the skin will show

degrees of radiation damage depending upon the dose, the time over which the therapy is fractionated, and the size, shape, and location of the port. These changes in the early stage may be erythema, epilation, a dry epithelitis, a moist epithelitis with formation of vesicles, and, provided the dose is high enough, necrosis. Late changes consist of telangiectasia, permanent epilation, atrophy, late ulceration and necrosis. Skin which has been subject to the effects of radiation in the past has an increased tendency to malignant degeneration.

The mucosa, where it is heavily irradiated, may show changes varying from a simple erythema to a vigorous mucositis with membrane formation and even necrosis. Similarly muscle and connective tissue may be damaged, although these tissues will tolerate a great deal more irradiation than will skin or mucosa.

Bone is also subject to radiation necrosis, and the degree of involvement of the bone depends upon such things as the dose, the period of time over which the therapy is fractionated, and the size of the port. There is also a strong dependence upon the quality of the *x*-ray used, since the quality of the radiation determines the amount of radiation which is absorbed by bone. In general, one may say that bone will tolerate about the same dose as normal skin or normal mucosa. However, in the presence of infection, it will tolerate far less. Therefore, it must be remembered that before a prolonged course of radiation therapy is begun, infected teeth must be extracted and the infection cleared up in order to lessen the danger of osteonecrosis. Just as bone may be devitalized as a result of radiation therapy, so may teeth be devitalized, and again we cannot stress too strongly the necessity for removing infected teeth before beginning a course of radiation therapy about the mouth. As a matter of fact, it is probably best to extract all teeth within the zone of radiation prior to the beginning of radiation therapy because it is well known that dental procedures (particularly extraction) years after a course of radiation therapy may result in osteonecrosis.

Radiation of much magnitude in a child will result in a stunting or a complete cessation of growth of bone and teeth. For this reason, one tries to avoid using radiation therapy about the epiphyseal lines of bone and about the face in young children.

In order to deliver the high dose necessary to destroy a malignant tumor, it becomes apparent that one must use every advantage in order to deliver the high dose to the tumor without giving more radiation than the normal tissues will tolerate. Some of the methods by which this is done are the use of multiple ports, the use

of a higher voltage, the use of more heavily filtered radiation, and the use of rotational therapy. Fractionation of the therapy over a period of several weeks is often necessary. The use of intra-oral and intravaginal cones in the case of small lesions is of tremendous value. Even though one employs every possible aid in minimizing the damage to normal tissues, still there is some unavoidable damage to normal tissues as a result of an intensive course of *x*-ray therapy. However, with well planned and judicious therapy, this damage can be kept to a minimum.

RADIUM

Radium therapy is not used nearly so much now as previously because of the tremendous advances which have been made in *x*-ray therapy equipment. However, there are still lesions which can be better treated by radium than by *x*-ray and still other lesions which are best treated by a combination of *x*-ray and radium. Examples of lesions in which radium therapy is used to very excellent advantage are carcinoma of the tongue, carcinoma of the floor of the mouth, and carcinoma of the cervix.

Radium, with an atomic weight of 226, an atomic number of 88, and a half-life of 1590 years, disintegrates into radon, a gas, by the emission of an alpha particle (an alpha particle is a nuclear particle consisting of two protons and two neutrons — that is, a helium nucleus). Radon, with an atomic weight of 222 and an atomic number of 86, has a half-life of 3.82 days. It disintegrates into radium A with the emission of an alpha particle. Radium A, with a half-life of three minutes, disintegrates into radium B with the emission of an alpha particle Radium B disintegrates into radium C with the emission of a beta particle (an electron) and a gamma ray photon. Radium C disintegrates into radium D with the emission of an alpha particle, a beta particle, and a gamma ray photon. This type of process continues until the stable element, lead, is finally formed. Thus, either radium or radon gas, with its equilibrium disintegration products, emits a combination of alpha, beta, and gamma rays.

Alpha rays, consisting of heavy helium nuclei moving at a relatively slow rate of speed, have very little ability to penetrate through matter, and are stopped by a very thin structure such as a sheet of paper. Beta rays, which consist of rapidly moving electrons, have much greater ability to penetrate through matter but, even so, can only penetrate through a very few millimeters of tissue equivalent material. They can be completely stopped by a thickness

of 0.5 mm. of platinum or gold. Because of their poor penetrating ability, the alpha and beta rays are undesirable in the treatment of cancer. Therefore, radium or radon *should be enclosed in a* container of a thickness of 0.5 mm. of either platinum or gold in order to filter out all of the alpha and beta rays.

The gamma rays emitted by radium or radon are similar to *x*-rays, except that they have a much greater energy per photon and, therefore, a much greater penetrating ability than the beam produced by the conventional *x*-ray therapy machine. The energy of the gamma rays of radium can be duplicated or even exceeded by supervoltage *x*-ray therapy machines, however.

The unit of quantity of radium is the milligram. If radon is used instead of radium, the unit of quantity of radon is the millicurie. There are two definitions of the millicurie, the first being the older definition and the one used to apply to radon only. That definition states: the millicurie is that amount of radon gas which is in radioactive equilibrium with 1 milligram of radium and, therefore, which *emits the same intensity of radiation.* In recent years many radioactive isotopes have been prepared, and the old definition of the millicurie is no longer sufficient. The newer definition of a millicurie is that it is that amount of radioactive material such that there are 3.7 times 10^7 disintegrations per second.

RADIUM DOSAGE

There are three things that determine the amount of radiation delivered to a tumor by radium or radon. The first is the amount of radioactive element used The second is the time that the radioactive material is left in place. These two factors are usually considered together, the time being multiplied by the quantity so as to obtain the units, milligram-hours or millicurie-hours. The third thing which determines the amount of radiation delivered to a tumor by radium or radon is the spacial distribution of the radioactive material within the tumor, and it is because of this third factor that dosage expressed in terms of milligram- or millicurie-hours is entirely inadequate.

One milligram of radium or 1 millicurie of radon filtered by 0.5 mm of platinum and used as a point source will deliver 8.4 roentgens per hour 1 cm. away from the source. The distribution of the radiation about such a source follows the inverse square law. For example, if we move from 1 cm. to ½ cm. away from a point source of 1 milligram of radium, the intensity will increase to 33.6 roentgens per hour. On the other hand, if we change from

1 to 2 cm. away from the source, the intensity will diminish to 2.1 roentgens per hour. In other words, there is a very high intensity of radiation immediately surrounding a radium or radon source, but the intensity of the radiation, as one moves away from the source, falls off very rapidly. Therefore, in order to give an adequate dose of radiation to all parts of the tumor, but to avoid an excessive dose of radiation in some parts of the tumor, the spacial distribution of the radioactive element becomes of tremendous importance.

Quimby has prepared tables of dosage for radium and radon whereby the total number of milligram-hours can be converted into dosage expressed as roentgens. These tables are based on an even or homogeneous distribution of the radium sources throughout the tumor. When the sources are distributed evenly throughout the tumor, the central portion will of necessity receive a higher dose than will the peripheral portions of the tumor However, in fairly small tumors (that is, in tumors of 100 cc. volume or less) this is of relatively little importance. Patterson and Parker have prepared tables of dosage whereby milligram-hours or millicurie-hours can be converted into roentgens, and their tables are based on an uneven distribution of the radioactive element within the tumor. The radioactive element is distributed throughout the tumor in such a manner that the doses to the various parts of the tumor are approximately equal. Rules for the distribution of the radium so as to give a homogeneous dose of radiation throughout the tumor are given with the tables of dosage and are readily available in the radiological literature.

In general there are four different types of radium applications. The first of these is the interstitial insertion of radium needles or radon seeds into the tumor mass. This is particularly applicable to such lesions as carcinoma of the tongue and carcinoma of the floor of the mouth. The second type of applicator is the surface applicator, and an example of its use would be in the treatment of a superficial carcinoma of the skin. A third type of radium applicator is the linear applicator, which finds a considerable variety of uses, the principal one being in the treatment of carcinoma of the cervix. A fourth type of radium applicator is the teletherapy unit, in which a large quantity of radium is placed in a protective device a considerable distance from the skin. The gamma rays emitted by the radium in this instance are used just as are the *x*-rays emitted by an *x*-ray tube.

Careful planning and precise execution of radium therapy is just as essential as it is in *x*-ray therapy. Therapy cannot be

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tumors for which radiation therapy is usually considered the treatment of choice, (2) tumors for which either radiation therapy or surgery may be used, (3) tumors for which a combination of radiation therapy and surgery is usually indicated, and (4) tumors for which surgery is usually considered the treatment of choice.

A. Radiation therapy usually the treatment of choice

(1) Mycosis fungoides
(2) Kaposi's sarcoma
(3) Carcinoma of the floor of the mouth
(4) Cancer of the nasopharynx
(5) Cancer of the tonsil
(6) Cancer of the base of the tongue
(7) Thymoma
(8) Neuroblastoma
(9) Carcinoma of the cervix
(10) Ewing's tumor of bone
(11) Reticulum cell sarcoma
(12) Hodgkin's disease
(13) Lymphosarcoma
(14) Leukemia
(15) Polycythemia vera

B Radiation therapy or surgery optional

(1) Carcinoma of the skin
(2) Carcinoma of the maxillary sinus
(3) Carcinoma of the lip
(4) Carcinoma of the mobile portion of the tongue
(5) Carcinoma of the buccal mucosa
(6) Carcinoma of the gingiva
(7) Carcinoma of the larynx
(8) Cancer of the esophagus
(9) Retinoblastoma of the eye

C Combination of radiation therapy and surgery

(1) Wilms' tumor of the kidney
(2) Seminoma of the testicle
(3) Cancer of the ovary
(4) Carcinoma of the endometrium
(5) Cancer of the breast

D Surgery usually the treatment of choice

(1) Malignant melanoma
(2) Cervical lymph node metastases, if fairly well differentiated squamous cell carcinoma
(3) Most tumors of the mandible
(4) Cancer of the lung
(5) Cancer of the thyroid
(6) Teratoma and dermoid
(7) Neurofibroma
(8) Cancer of the stomach
(9) Cancer of the colon
(10) Tumors of the salivary gland
(11) Cancer of the pancreas
(12) Adenocarcinoma of the kidney

successful and result in cure unless all portions of the tumor receive a lethal dose. On the other hand, it is undesirable to give an excessively high dose in any one area.

RADIOACTIVE ISOTOPES

With the exception of cobalt 60, phosphorus 32, iodine 131, and gold 198, the radioactive isotopes offer little at this time in the treatment of cancer

Radioactive cobalt has several advantages over radium. The gamma ray emitted by cobalt 60 is more penetrating than that emitted by radium, and no alpha rays are emitted by cobalt. The beta rays emitted by cobalt are extremely weak and can be filtered out with little difficulty. A great advantage of cobalt 60 over radium is that no gaseous daughter element is produced. Furthermore, radioactive cobalt can be made into a greater variety of size, shape, and strength applicators with greater ease than can radium. Now that radioactive cobalt is readily available, it may in time replace radium.

Radioactive phosphorus is now the treatment of choice for polycythemia vera, and it is of considerable value in the treatment of leukemia. Radioactive iodine, although of great value in the treatment of hyperthyroidism, is of limited value in the treatment of carcinoma of the thyroid. Gold is of considerable value in the treatment of malignant, pleural and peritoneal effusions.

INDICATIONS FOR RADIATION THERAPY

The choice as to whether to use surgery or radiation therapy in the treatment of a malignant tumor depends upon such things as the location and extent of the tumor and its histology. One should not have the impression that a tumor should be removed surgically if possible and treated by radiation therapy only if the tumor is inoperable. In many lesions the curability is higher if treated by radiation therapy than if treated by surgery, and in such lesions radiation therapy is obviously the treatment of choice. In other lesions the curability is no higher with radiation therapy than with surgery, but because of a better cosmetic and functional result, radiation therapy may be the treatment of choice. In still other lesions there is considerable difference of opinion as to whether surgery or irradiation is the treatment of choice; and in these instances it is very likely that either method will give an equally satisfactory result. The various tumors, according to the choice of treatment, can be divided into four groups: (1) those

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Maxillofacial Prosthetics in Patients With Cancer

By Ralph S. Lloyd,* B.S., D.D.S.

In the treatment of cancer of the head and neck defects are encountered which not only are unsightly but also affect the nutritional and emotional balance of the patient. The treatment of cancer may result in destruction of the nose, portions of the face, hard or soft palate or the masticatory apparatus. Defects of this type occur regularly in the proper treatment of cancer, as it is necessary to resort to radical treatment to make certain that all the involved tissue is removed or destroyed and to reduce the incidence of recurrence of disease.

Both reparative surgery and maxillofacial prosthesis have been used for centuries in the repair of defects due to such diseases or to congenital deformities of the oral cavity, face and head. Experience has confirmed the benefits of coordinating the activities of the surgeon and the maxillofacial prosthodontist. The two services were not integrated in their objectives until recently. As a result of the casualties of the two World Wars, much progress in the methods of restoration has been made.

The maxillofacial prosthodontist attempts to restore by mechanical means the defects created by the treatment of cancer. They are not substitutes for plastic surgery. There are, however, some reasons why maxillofacial prosthetic procedures are chosen instead of plastic surgery to remedy such defects.

In the treatment of cancer the area affected must be periodically examined for evidence of recurrence of the disease. If the area is obscured by a graft of tissue, a recurrence of the disease may be hidden. If a prosthetic device, such as an external nose, is utilized, it may be easily removed for inspection of the underlying tissue

Patients with cancer are usually in the older age group. Some of

*Chief, Dental Department, Clinical Center, National Institute of Health, Bethesda, Maryland

(13) Cancer of the urinary bladder
(14) Carcinoma of the vulva
(15) Osteogenic sarcoma
(16) Chondrosacroma
(17) Sarcomas of the soft tissues such as fibrosarcoma, liposarcoma, or rhabdomyosarcoma

In summary, radiation therapy has during the past half century assumed an illustrious position in the treatment of cancer. Since inadequate irradiation results in a decreased radiosensitivity of the tumor and a decrease in the ability of the normal tissues to tolerate large doses of radiation, one may well say that there is only one chance to cure cancer with radiation therapy. An inadequate dose in any part of the tumor will result in failure. On the other hand, an excessive dose will result in necrosis Before attempting radiation therapy, one must be thoroughly grounded in radiation physics, radiation biology, and must have a knowledge of the characteristics and behavior of malignant tumors. Therefore, radiation therapy should be given only by physicians who are specially trained in that field. With early diagnosis, followed by prompt and adequate therapy, the results are most gratifying.

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Patients with cancer are usually in the older age group. Some of

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these patients refuse to submit to the time consuming procedures of plastic surgery because of their age. Expense is also a factor.

A patient being treated for cancer may have a known shortened life expectancy. In this case maxillofacial prosthesis should be the treatment of choice. Quite often the remaining life of the patient can be made happier if his appearance is improved or if he can be helped to eat and speak more normally.

Often the area involved may have been irradiated, creating a hazard to the success of a tube graft. In this case prosthetic procedures should be instituted.

The last contraindication for plastic surgery is the difficulty of duplicating certain parts of the head by surgical means. If such surgery can be instituted successfully after a period of observation, then plastic surgery is certainly the treatment of choice. It is, however, difficult to reconstruct a presentable external ear by means of plastic surgery, and it need not be said that it is impossible to construct an eye. These typical problems are rather easily solved by maxillofacial prosthetic methods.

The dentist is eminently qualified in the field of maxillofacial prosthesis because of his training. He is familiar with the properties and means of handling most of the materials used in the field. He is also familiar with many of the procedures used such as the taking of impressions and the making of positive and negative molds. Sculpturing is not far afield from dentistry because the dentist is trained in carving models and has studied anatomy. The dentist understands the anatomy, pathology and physiology of oral tissues as well as the mechanical principles involved in deglutition and phonation.

We certainly must be cognizant of the fact that the dentist is fully qualified for the valuable and tedious procedures concerned with rehabilitation of the cancer patient. Many of the oral problems of the patient obviously can best be solved by the dentist.

The field of maxillofacial prosthesis is very interesting to the dentist, and the problems involved are not as difficult as they first appear. They usually can be solved by good treatment planning and by using imagination. The construction and design of an obturator is a good example The task of remedying a defect in the maxilla with an opening between the mouth and the nasal cavity seems a formidable procedure to the average dentist. The problem usually is not difficult, and one can only recommend that an effort be made to remedy the defect

Frequently the cases are not remunerative except in the personal satisfaction of helping a patient in need. The people affected are

appreciative of any effort one can make. If a patient is disfigured, he is apt to become a social recluse. Defects of the oral cavity are just as disabling because normal speech is usually interfered with, and it is difficult for the patient to eat properly.

Acquired maxillofacial deformities may be classified under three groups:

1. Intraoral deformities
   - A. Maxilla
     - (1) Partial resection of maxillary bone
     - (2) Total resection of maxillary bone
     - (3) Partial or total resection of soft palate
   - B. Mandible
     - (1) Partial mandibular resection
     - (2) Total mandibular resection
2. Extraoral or facial deformities
   - A. Loss of portion or all of the nose
   - B. Loss of an ear
   - C. Loss of portion of the cheek tissue
   - D. Loss of an eye and surrounding tissue
3. Combined intra- and extraoral deformities

DEFORMITIES OF THE MAXILLA

The treatment of tumors in the region of the maxillae may require surgical intervention. The resection of pathological tissue and some normal surrounding tissue may result in a minor deformity or small perforation of the palate More often it results in a gross defect caused by resection of a portion or all of the hard palate and alveolar ridges causing a wide communication to exist between the nasal and oral cavities. Patients with such deformities present a postoperative problem. For some time after the operation one may have to resort to nasal feeding. Speech is difficult if not impossible. The usual treatment is to cut a soft rubber sponge to approximately fit the defect. The sponge is used to help close the opening between the nasal and oral cavity. A difficulty encountered is that the rubber sponge absorbs food debris and the secretions of the nasal and oral cavities. It is very difficult to keep clean and usually has to be done by a nurse Cleaning is a disagreeable task, particularly since a sponge does not fulfill the function for which it is intended. It is a simple prosthetic problem to solve this dilemma. A temporary appliance can be constructed rather easily. It is urged that temporary appliances be constructed as soon as possible to restore the continuity of the oral cavity.

Temporary appliances can be started preoperatively or they may be constructed several days postoperatively. Temporary appliances or obturators are satisfactory even in edentulous mouths. Insertions of such devices produce immediate results. Temporary obturators aid the patient in speaking, eating, drinking and smoking. In addition, they maintain facial contour by counteracting scar tissue contraction.

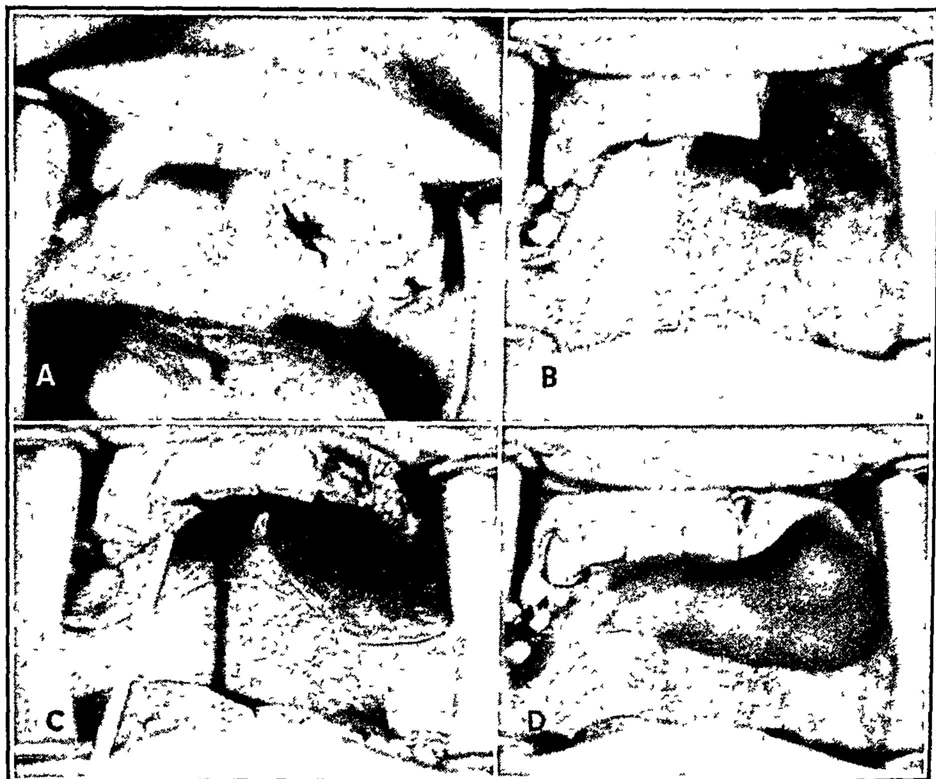


FIG 7 *A.* Adenocarcinoma of accessory salivary gland of hard palate *B.* Defect of hard palate after surgery. *C* Clear acrylic tray made before operation in place after resection *D* Temporary obturator

One very simple way to handle this type of case is to press a clear acrylic tray over the model of the normal mouth obtained before the operation (Fig 7). This tray should extend up into the periphery and over the teeth and palate. It can be inserted at the time of operation regardless of the number of teeth to be extracted, and the teeth that remain will hold the tray securely in place. Gauze packs can be applied by placing them in the defect before insertion of the tray. The patient will receive comfort out of this device because he will be able to eat and speak more

normally. As soon as his general condition permits, the temporary obturator can be constructed.

Fundamentals of good clinical practice should be observed in the construction of any maxillofacial prosthetic device. A good history should be obtained and recorded. An accurate examination of the affected area should be performed. In the case of maxillary deformities the remaining teeth and supporting structures should be completely examined. X-ray films of all teeth and tissues should be obtained, and the teeth should be tested for vitality. Good treatment planning will include study models. The mouth should be restored as near to normal as possible by means of periodontal treatment, relief of traumatic occlusion, and dental operative procedures. In a jaw resection case, it is advised that all teeth be retained as long as possible. They may be utilized for retention at a later date.

The construction of a hard palate obturator is not difficult. The technic for obtaining the impression seems to cause the greatest concern among dentists. The first impression should be concerned only with the remaining normal hard palate and teeth. Hydrocolloid impression material is preferred, but it may be necessary to use an alginate material because of the mechanical difficulty of introducing a tray into the mouth of a patient with trismus.

A satisfactory tray can be cut and contoured from an ordinary edentulous aluminum tray. The periphery of the tray is short which will allow it to be introduced into a partially opened mouth. Alginate material will adhere to the tray if it is prepared by the following technic: The tray is heated and compound is traced or smeared on its surface. While the compound is "tacky," shredded cotton is applied. The cotton will adhere to the compound and the fibers that protrude will hold the alginate material. The defect in the hard palate may be obliterated by means of petroleum jelly gauze. This will prevent impression material from passing into the nasal passages. When an impression of the remaining teeth is obtained, a model is poured. A metal skeleton is designed and constructed so that it will have a predetermined path of insertion and maximum retention. Hard shellac base plate material is fixed to the gold or vitallium skeleton and contoured and shaped into the defect to nearly approximate the desired extension. This is done by warming the base plate and trying and retrying the case in the mouth This base plate may be corrected further by the addition of low fusing stick compound and retrying in the mouth. When the skeleton and base plate is properly extended and trimmed, the final corrective impression is taken with a small

amount of zinc oxide paste impression material. The original model is then cut so that the base plate and corrected impression can be seated on the original model. Additional stone is poured onto the old model and around the new impression completing the working model.

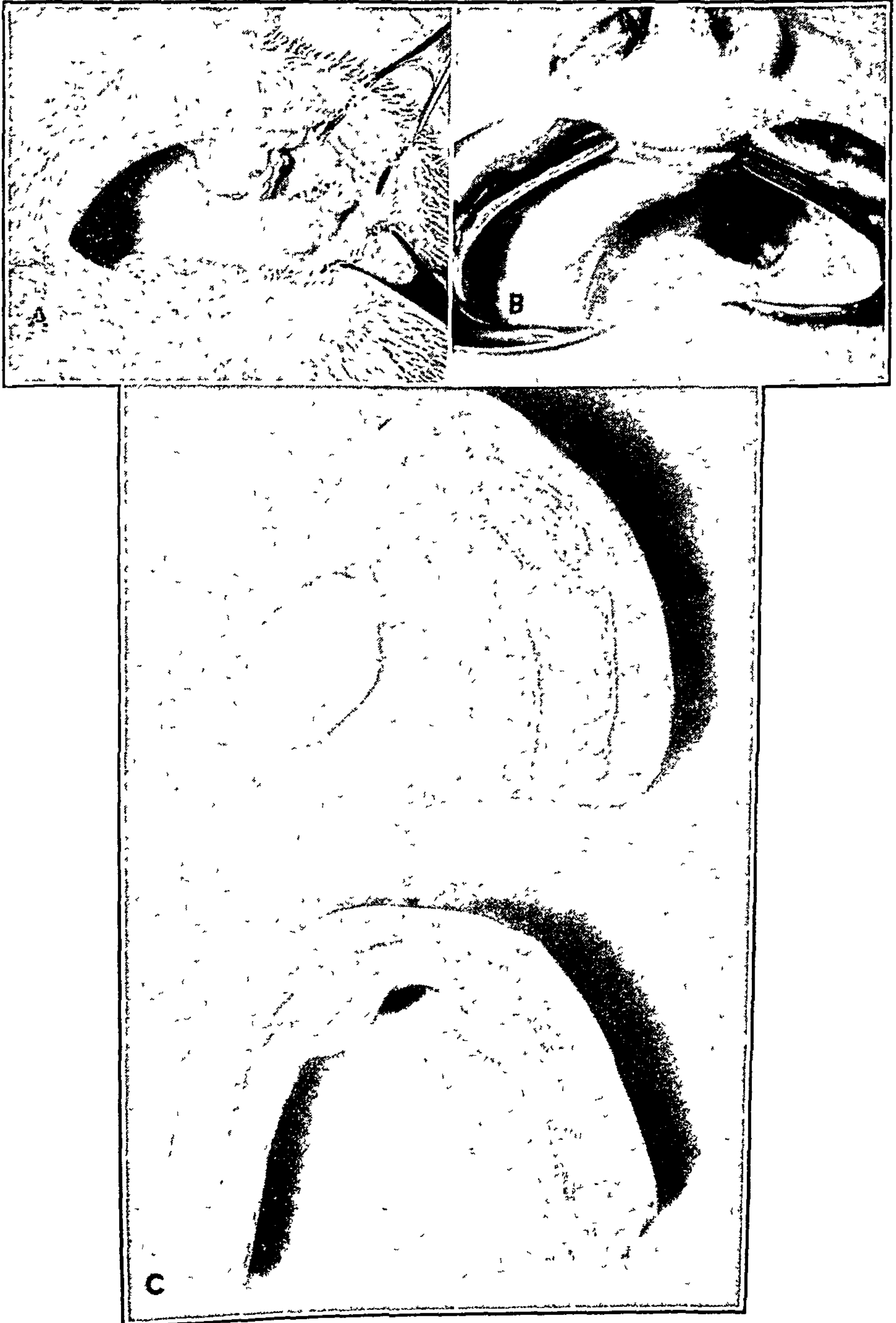


FIG. 8. *A.* Squamous cell carcinoma Alveolar ridge. *B.* Defect. *C.* Prosthesis.

It is not necessary or advisable to replace missing teeth on the temporary appliance. Our chief concern is restoration of continuity of the oral cavity. If artificial teeth are placed on the appliance in areas which are not supported by underlying bone, excessive lever-

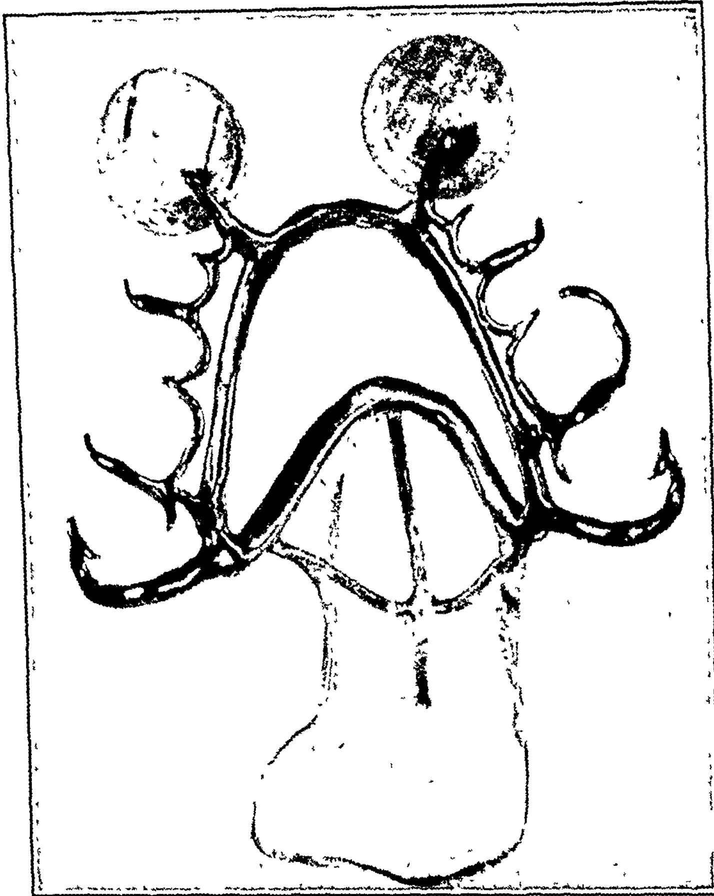




Fig. 9 Fixed type obturator.

age will be transmitted to and exerted on the natural teeth which are clasped. Consequently, the natural teeth that are necessary to continued success of the case will be lost prematurely.

Successful appliances can be constructed for partial maxillary resection cases which are edentulous in the remaining maxillary and mandibular arch (Fig. 8). Palate pieces can be constructed which will obliterate the opening between the nasal and oral cavities. If the periphery of the palate piece is muscle trimmed on the normal side of the mouth, placed above the muscle attachments of the cheek on the side of the defect so that the cheek will fold over the obturator and tend to hold it up in position, retention can be obtained. Projections into the nasal cavity are not usually of much value. The nasal mucous membrane is not very resistant to trauma, and ulceration often results. The mucous membrane over the pharyngeal side of the soft palate is more resistant to trauma so that a projection of the denture may be placed over the soft palate. This may aid in retention. Occasionally it is advisable to set up articificial teeth on the edentulous palate piece articulating with the lower dentition. This will enable the patient to bite the prosthesis into place when it becomes loosened.

Surgical clefts of the soft palate sometimes result from treatment of tumors. The problems involved in the construction of a prosthetic device for them are similar mechanically to those for congenital clefts. There is one important difference. The result and success of an obturator for a surgical defect of a soft palate is immediate because the patient remembers how to swallow and how to phonate. Usually obturators with the fixed type of velum are indicated because scar tissue may limit the movement of the remaining soft palate (Fig. 9).

DEFECTS OF THE MANDIBLE

Mandibular defects resulting from the treatment of primary malignant bone tumors, or bone secondarily invaded by cancer, usually are those resulting from a partial or total jaw resection. Treatment of cancer of the floor of the mouth and mandibular alveoli offers some unusual problems. Cancer in these sites, treated by radiation, may be followed by exposure of the bone of the mandible and eventually by osteoporosis, necrosis and osteomyelitis. Occasionally this inflammatory process becomes chronic and resists treatment. Trismus occurs and the patient becomes debilitated. Partial mandibular resection may be the best treatment It is a recognized rule that when cancer invades the mandible, the bone

must be widely resected. The mandible is divided anteriorly to the involved area and the diseased portion disarticulated and removed. The remaining fragment is pulled downward, inward and is rotated by muscle traction. This results in loss of control of the movements of mastication and the patient is unable to articulate the remaining teeth. Appliances may be constructed to supply an artificial joint and to control the movement of the remaining fragment. By this means mastication of food is facilitated. There have been many ingenious designs for this type of appliance. One type of artificial hinge is shown in the illustration (Fig. 10). It

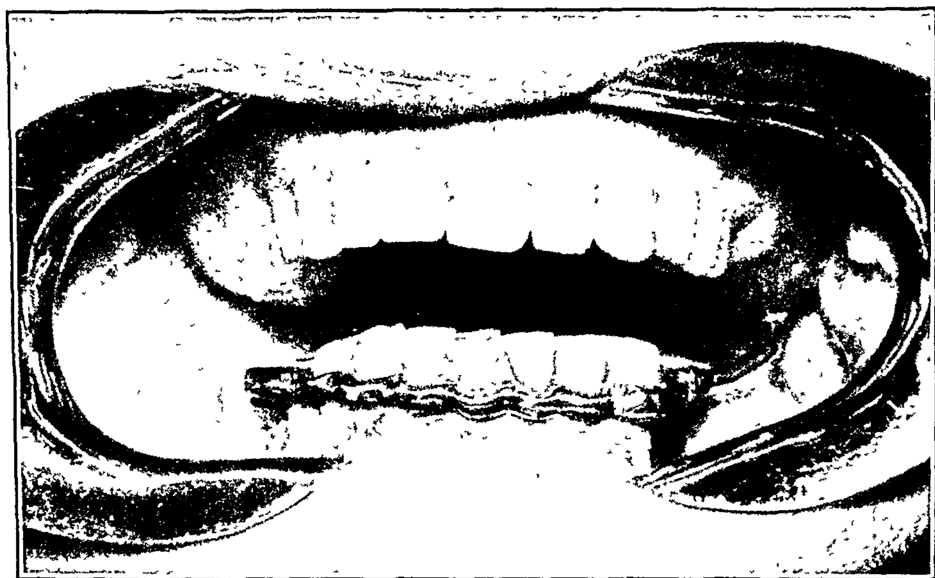


FIG 10 Prosthesis for mandibular resection with interconnecting bar.

consists of a sliding joint above into which a ball articulates and is attached to a bar which hinges into the lower appliance. The most difficult problem in the construction of this appliance is to obtain adequate retention particularly in the mandibular appliance. The circumferential type of clasp, which is shown in the illustration, encircles and clips around the lower dentition, but it is somewhat difficult for the patient to apply.

Ordinarily, adequate retention may be obtained by the application of a continuous clasp on the lingual surface of the remaining teeth (Kennedy bar) and by using Roach (T) clasps on the buccal or labial surface of several of the remaining teeth. If the case is surveyed and well designed, the appliance will be very stable, and it will be easy for the patient to insert. This is important because the patient also has to contend with the insertion of the ball into the sliding joint on the upper denture.

Occasionally a patient has sufficient control of the movements of the lower fragment of the mandible making it unnecessary to use a bar between the lower and upper jaws (Fig. 11). If the posterior of the maxillae is edentulous, a wide occlusal surface in plastic can be built lingual to the artificial teeth. This will compensate for some lack of control of the mandible.



FIG 11 Prosthesis for mandibular resection without interconnecting bar

Total jaw resection is a rather hopeless problem for the maxillofacial prosthodontist, and the only alternative is for the plastic or oral surgeon to attempt a bone graft.

EXTRAORAL OR FACIAL DEFECTS

A large percentage of all cancers are of the skin which is exposed to sunlight The rigorous treatment of cancer of the skin may destroy portions or all of external organs such as the nose or an ear (Fig 12). Large defects may result if the lesions are on other parts of the face such as the cheek, eyelids, etc Plastic surgery is the treatment of choice in similar defects caused by trauma. Neoplastic lesions may present factors which, as we have stated before, contraindicate plastic surgical procedures. If factors such as examination for recurrence of the lesion, age of the patient, or the presence of known metastatic lesions can be eliminated, then surgery is the treatment of choice, provided of course, that it is tech-

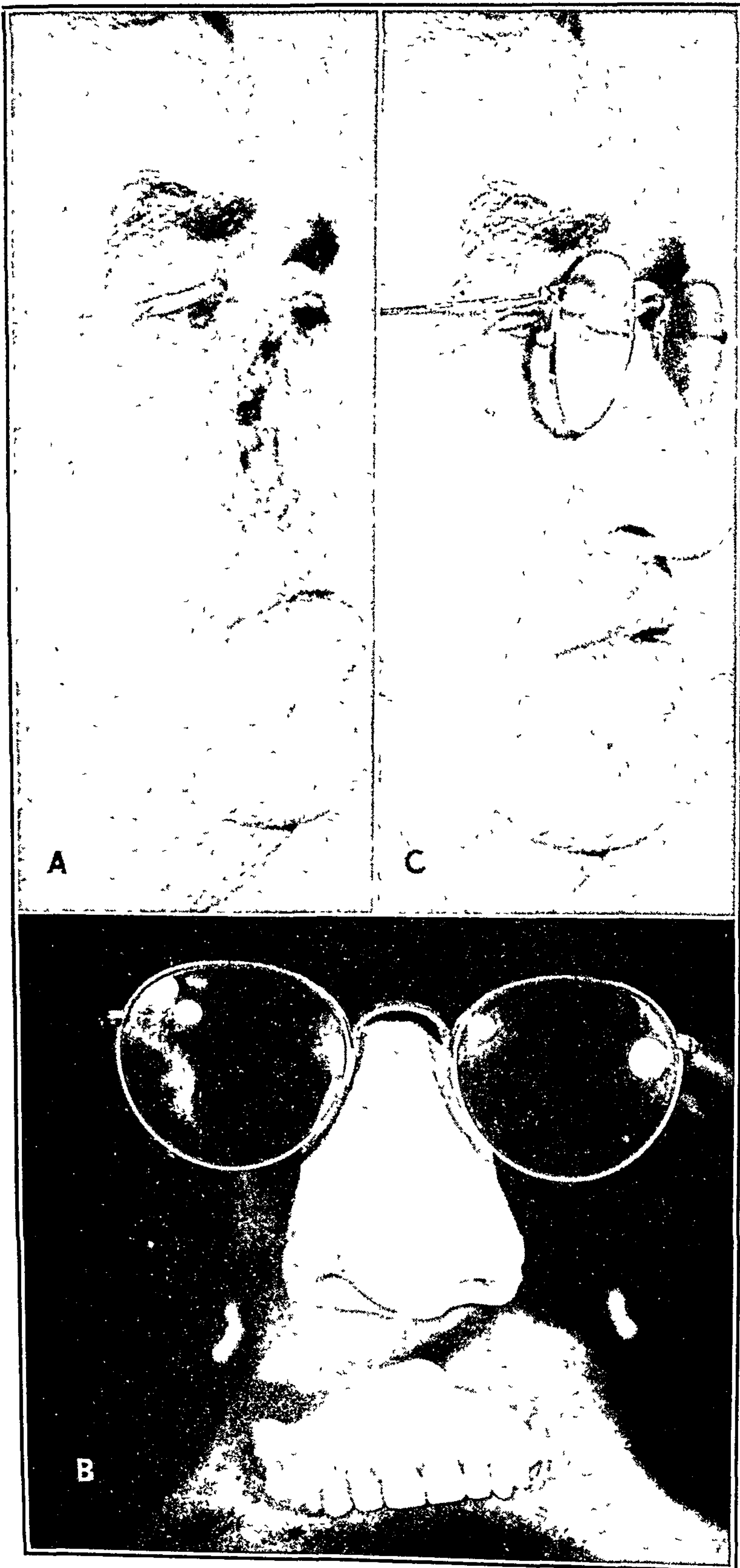


FIG 12. *A.* Nasal defect—collapsed upper lip. *B.* Nasal prosthesis with obturator. *C.* Nasal prosthesis in place.

nically possible to duplicate a structure by means of plastic surgery (Fig. 13).

Prosthetic appliances may be a temporary expedient to aid the patient until it is advisable to proceed with plastic surgery. There are, however, a great number of patients who will have to be treated entirely by maxillofacial prosthetic means.

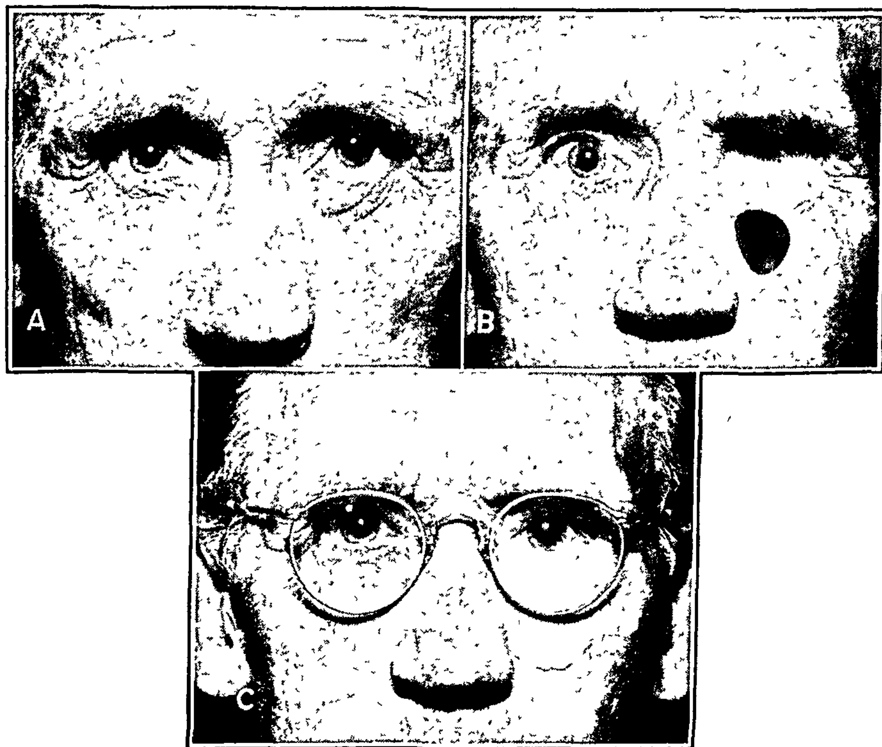


FIG 13 *A.* Squamous cell carcinoma — inferior palpebrum. *B.* Defect *C.* Prosthesis

There are ideal standards which we must try to approach in the construction of a prosthetic device to reproduce external skin:

1. The result must be esthetic. The finished device should not attract attention in ordinary social intercourse. If the device does not attract attention at the distance of a few feet, it can be considered successful.
2. The prosthetic device must be comfortable so that it will not constantly remind the patient of its presence.
3. The prosthetic device must be easily cleaned without altering its physical appearance. Since these devices are worn on the exposed part of the face, they are bound to become soiled.

4. An ideal prosthesis should be rugged and durable so that it will stand the rigors of daily wear. A device which has to be remade constantly is an annoyance to the patient as well as to the operator.
5. The means of retention must be adequate so that the patient is not in constant fear of its being dislodged. The device may be retained by use of adhesives or by mechanical means such as eye glasses or natural undercuts.

The materials which have been used for the construction of facial prostheses are many. Vulcanite, metals such as copper and aluminum, celluloid, gelatin and glycerin mixtures, prevulcanized latex and various plastics are such examples. Some of these materials are still in use today.

There are a number of desirable qualities which a material should possess for the ideal facial prosthesis.

1. It must be compatible with tissues.
2. It should be soft and flexible so as to approach the texture of flesh
3. It should approach the translucency of skin and flesh.
4. It must be lightweight
5. It must be easy to mold.
6. There should be little volumetric change either on processing or subsequent exposure to air.
7. It should be stable in color and physical appearance to the rays of the sun, heat, cold, water and oils.
8. It should be inexpensive so that experimentation with the device will be encouraged.
9. It should be washable.
10. It should lend itself to coloring both intrinsically and extrinsically.

The rigid and elastic resins seem to fulfill most of the requirements of an ideal material for the construction of external facial prostheses.

The technic for construction of various types of external facial prostheses is basically similar except for minor deviations demanded by the anatomy of the structure to be reproduced.

There are more indications for the construction of an artificial external nose than for any other part of the face. The technic for the construction of an external nose is as follows:

1 Obtain an adequate impression of the defect and surrounding tissues A full face impression from the chin to the hairline should be obtained. Various types of impression material can be used successfully. Plastic, hydrocolloid and alginate materials all have

their indications for use. Plaster is probably the most widely used. The eyebrows and eyelids should be well lubricated with petroleum jelly. The nares can be stopped with wet cotton or gauze to prevent the impression material from going into the nasal passages or undercuts. The patient should be in a relaxed semi-reclined position. He will be able to breathe through the mouth if the impression material is carefully applied. A model is poured in dental stone in the finished impression.

2. A wax model of the external nose can either be sculped or be obtained by impression of a nose of another person of similar proportions. A hydrocolloid impression of the donor nose is obtained. Melted wax is poured into the cooled, moist impression The wax is immediately poured out. Wax is again and again poured into and out of the impression until the desired thickness is obtained The model is cooled and removed from the hydrocolloid impression. When it has been trimmed to fit approximately, the wax model of the nose can be softened in warm water and gently adapted to the case. Care should be taken to preserve the skin texture in the wax because the average worker has difficulty duplicating skin texture. Failure to preserve the skin texture may mean the difference between a natural or artificial looking appliance Skin texture can be duplicated very well in the sculptured wax nose The wax model, after it has been fitted and accepted by the patient and the prosthodontist, is fixed to the stone model After a separating solution has been applied, stone is poured over the wax and onto the stone model. When this has hardened, the wax is removed from the mold The nose is then made hollow by replacing the wax to the thickness desired for the finished appliance. An inner core is then poured through a hole bored in the back of the model. The wax is eliminated, and the case is ready for finish

3. If hard acrylic resin is the material of choice, the case will have to be imbedded in plaster in a metal flask. If soft plasticized resin is the material of choice, flasking the case will not be necessary.

4 Hard acrylic resin can be colored intrinsically by the addition of colored opacifiers such as face powder and/or by adding oil soluble dyes to the monomer Much experimentation is needed to assure the operator that the correct color is formulated before the prosthesis is processed. Clear acrylic will attain about the correct amount of opacity by the addition of two per cent by weight of face powder or zinc oxide. The soft plastics are precolored intrinsically by the manufacturer.

5. An external nasal prosthesis can be retained on the face either by the use of liquid adhesive or by attaching the prosthesis to glasses. Any inherent undercuts in the defect might also be utilized for retention.

6. The wearing of an external prosthesis is a very real problem for the patient to solve. If the patient really desires to wear a prosthesis, he will do so. Proper instruction to the patient and proper construction of the device will aid. Retention will be facilitated by designing the device so that the base of the artificial nose will rest upon as much tissue as is compatible with its form.

Other external defects of the head can be constructed in a similar manner. The ear presents particular difficulties in sculpturing. Some help can be derived from the use of a mirror to reverse the image of the opposite normal ear. It is also a difficult problem to obtain retention of a prosthetic ear. It has been suggested that an epithelial lined pocket be constructed which will hold a thin gold projection from the inner surface of the ear above the external auditory canal. This mechanical retention, in addition to the use of adhesives, may hold the artificial ear securely in place.

PROTECTIVE APPLIANCES IN RADIATION THERAPY

The type of treatment selected for lesions of the oral cavity and face depend upon the character of the lesion and the judgment of the clinician Most of the defects of the oral cavity and face are the results of adequate surgical treatment of cancer. We must remember that the first treatment of a malignancy is the one which presents the golden opportunity for a cure. Therefore, the first treatment should be intensive enough to insure a cure

Radiation therapy may be the treatment of choice. There are several types of radiation used in the treatment of cancer. External radiation is that type applied to the surface of the body from an outside source such as an *x*-ray therapy machine and radium applicators (plaques, bombs, molds, etc.). Interstitial radiation is that which is obtained by the insertion of radium needles or radon seeds into the tissue of the tumor.

It is an axiom that irradiation must be sufficient to insure that the tumor will be devitalized. If this is done, normal surrounding tissue will be affected. It is possible, however, to construct devices which will help protect the normal surrounding tissue from the effects of irradiation beyond their normal tolerance. The dentist can be of great assistance to the radiologist in the preparation of lead shields which must be contoured to fit the part of the body being treated.

Extraoral protective lead shields can be adapted and cut out to the size of the opening necessary for treatment directly on the patient. However, when the lesion is in an irregular position such as below the inner canthus of the eye, it is best to make an anatomically fitting lead mask (Fig 14). If a dental stone model is obtained, it is a simple matter to swage a lead mask which will fit the tissues accurately. An aid in technic is to outline the area of treatment on the patient with an indelible pencil. This indelible



Fig 14. Anatomical lead shield.

mark will be transmitted to the plaster impression. A groove is cut in the impression over the outline made by the indelible pencil. This groove will be transmitted to the finished model in the shape of a ridge which will mark the lead where the opening is to be cut. Lead protective devices in contact with tissues should be coated with a film of paraffin to prevent reaction and discoloration of the tissues (especially skin) caused by the characteristic and scattered radiations emitted by the edges of the lead when struck by the therapeutic rays.

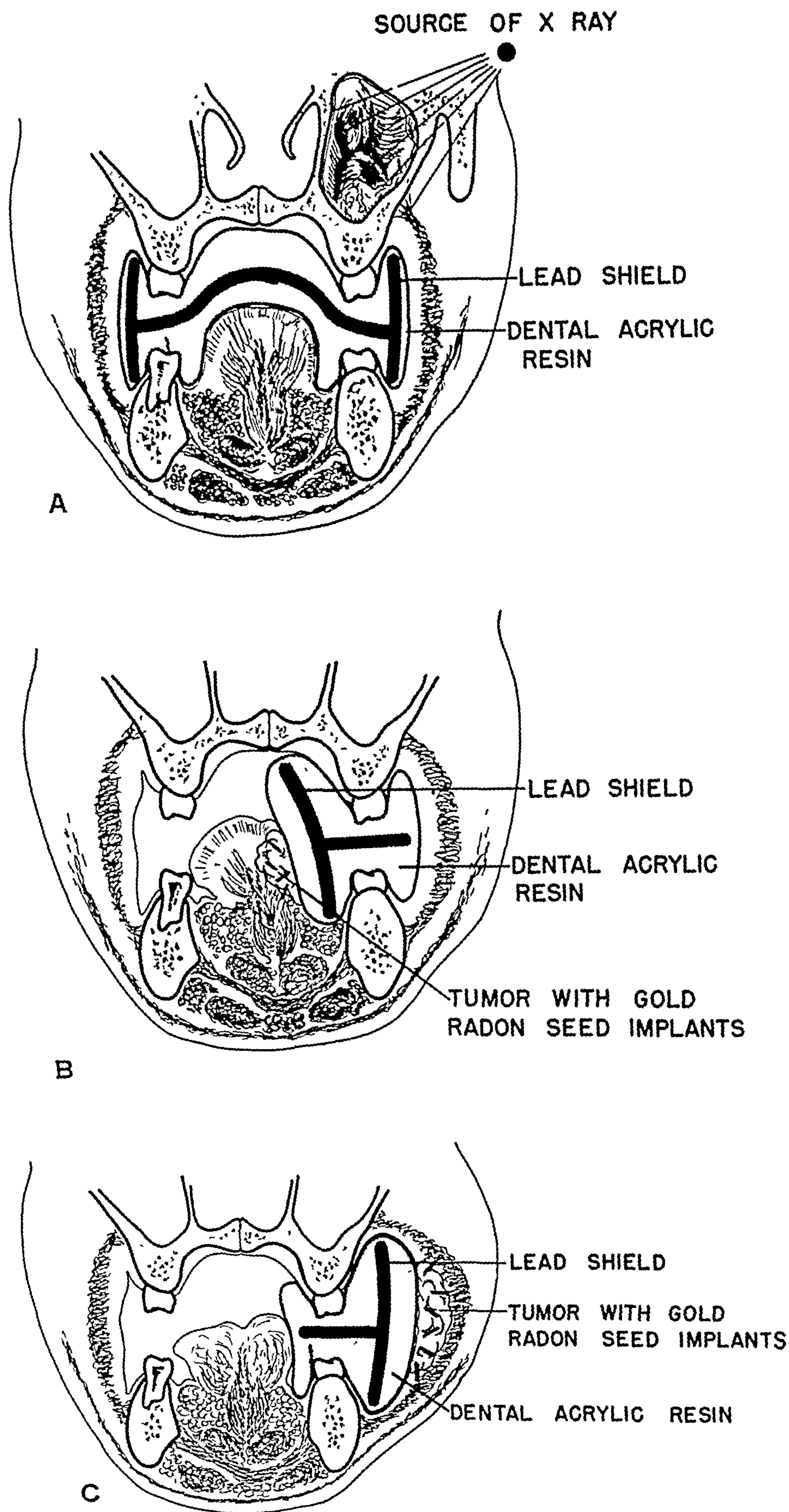


FIG 15. *A B. C.* Intra-oral lead shields used to protect normal tissue.

Intraoral appliances may be designed to protect the uninvolved, adjacent parts of the mouth, particularly the bony structure of the alveoli and the roof of the mouth (Fig. 15). Intraoral protective appliances should take advantage of the absorption properties of lead. By incorporating lead shields within the device, normal surrounding tissues will be shielded. The intraoral protective device also increases distance between the normal tissue and the tissue to be irradiated. This is to take advantage of the fact that the intensity of radiation diminishes inversely as the square of the distance from the source. If the intensity of radiation at the surface of a lesion beneath which a radon seed is implanted 1 cm. deep is assumed to be 100 per cent, the intensity at a point 1 cm. further away will only be 25 per cent.

A practical example of this can be illustrated in the treatment of a lesion of the buccal mucous membrane of the cheek. If a shield is not used, and radon seeds are implanted in the lesion, the adjacent normal alveolar ridge will be in contact with the surface of the lesion and thus receive a 100 per cent therapeutic dose. If the shield is constructed to hold the affected cheek 1 cm. away from the alveolar ridge, the alveolar ridge will receive 25 per cent of a therapeutic dose. If the shield is constructed to hold the cheek 2 cm. away, the alveolar ridge will receive 11 per cent of a therapeutic dose. If a lead shield is incorporated in the appliance, we will have a further reduction of dose to the normal alveolar ridge.

This illustrates the necessity of combining bulk to achieve distance and a lead shield to obtain the absorption effect to protect the normal surrounding tissue.

CONSTRUCTION OF PROTECTIVE APPLIANCES

A dentist can easily construct such a protective appliance to aid in the treatment of cancer. The technic is neither difficult nor time consuming. All appliances differ in their requirements and applications. Some suggestions may be obtained from the illustrations. In general the technic is as follows:

A lead shield is formed and adapted so that the area to be treated is isolated. In a tumor of the cheek, for instance, the lead shield is contoured to fit and should extend to the superior and inferior mucobuccal fold. The lead should be sufficiently thick to reduce the dosage rate through the lead to 5 per cent or less of the useful beam. A projection is soldered in the lead to fit between the teeth. The lead should be approximately one-eighth of an inch thick. Compound is softened and placed on the lead shield between the

teeth and up and down over the alveolar tissue. The teeth are occluded into the soft compound. Compound is then added onto the lead shield on the cheek side to the desired thickness. This compound protective appliance may be used without further processing if time is a factor. If it is possible to do so, it is best to replace the compound with denture acrylic or some quick curing plastic resins.

There are quick curing plastic resins which are used to construct base plates and impression trays. This is an ideal material to use. It does not require flasking, and it can be molded into the desired shape on the model of the alveolar ridge and teeth.

The technic for construction of a protective appliance will differ in each case. It is impossible to describe the technic to be used in all cases. If some imagination and ingenuity are used, the patients will benefit.

There is one word of caution to the dentist who is dealing with a patient who is to receive radiation therapy. Teeth which will be in the field of radiation should be extracted before extensive roentgen therapy is applied. Teeth should never be extracted after they and their supporting structures have been heavily irradiated. Such a procedure will result in radiation necrosis of the alveolar bone. A protective appliance will, of course, help prevent this unfortunate circumstance.

RADIUM APPLICATORS

The source of external radiation may be radon tubes or radium In order that radium or radon may be applied to the lesion at a predetermined distance and distribution which is determined by a radiologist, it is necessary that an applicator be constructed (Figs. 16 and 17). This applicator can be constructed by the use of an impression of the area affected. The impression will duplicate the lesion, thus the area may be measured so that the dosage can be computed. Radiologists may differ in their mode of application of the radon tubes. One may apply the tubes directly on the lesion while another may determine that a certain distance away from the lesion is desirable (Fig. 18). Two types of applicators can be constructed. The first and more common is constructed in acrylic or compound. Slots to accommodate the tubes are cut into the material a known distance from the lesions and in definite positions to assure proper distribution of the rays. The tubes can be secured in the slots by paraffin or dental sticky wax. These applicators can be held in place in the oral cavity and around the

lip by a projection between the alveolar arches or between the teeth on which the patient may bite. Normal surrounding tissue can be protected somewhat by utilizing the factor of distance. The shield should be built so that the affected tissue is isolated from the normal surrounding tissue as much as possible. Lead shields can be incorporated into the applicator, and they may aid slightly by absorbing some of the radiation.

The other type of applicator is one which is contoured over the lesions as thick as the distance which the radon seeds or tubes are



FIG 16 A. Squamous cell carcinoma. *B* Radon tube applicator and bite blocks. *C* Same in place.

to be held away from the lesion. This type of applicator is best used extraorally It can be made of paraffin wax which can be purchased in thin sheets. These sheets can be fused together until the desired thickness is obtained. The radon tubes are placed on the outside of the applicator after the wax has been adapted to the lesion and surrounding tissue. It may be a needless warning, but the first rule is that no tube, needle or plaque containing radium

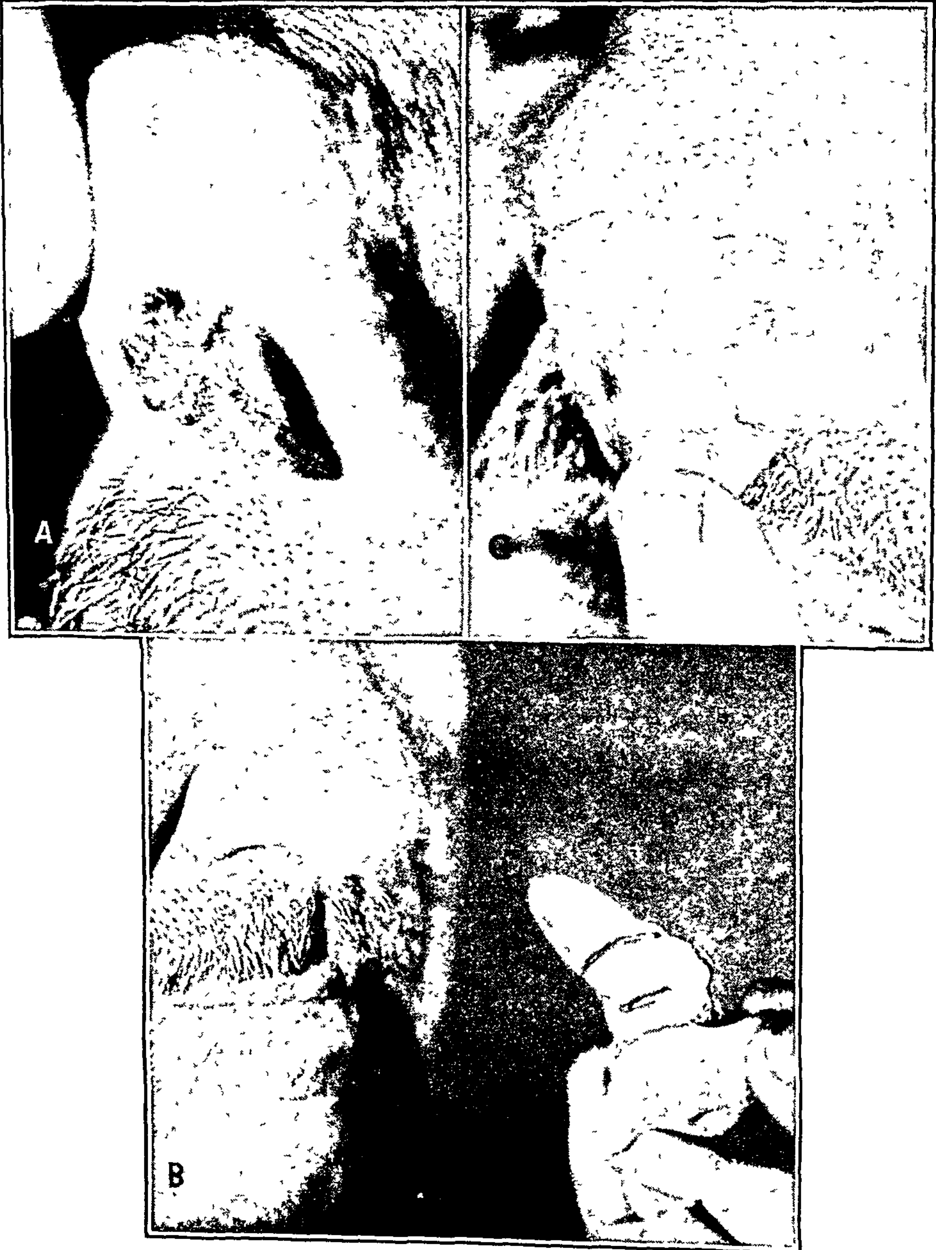


FIG 17 *A* Basal cell carcinoma—inside nose. *B* Radon tube applicator. *C* Radon tube applicator in place.

or radon should ever be handled with the fingers Forceps should always be used. Radium or radon should always be handled by a radiologist.

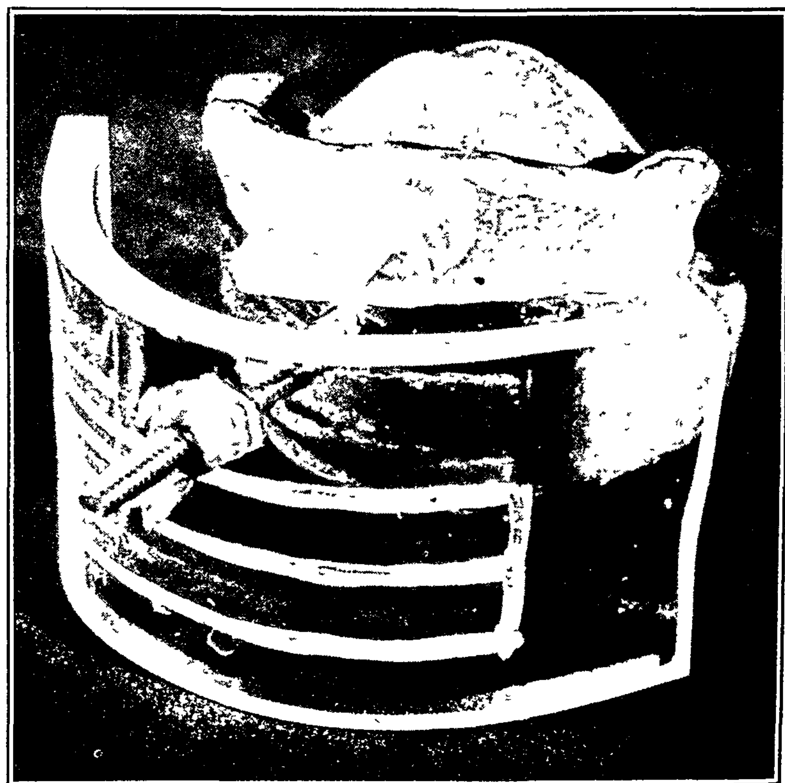


FIG. 18 Radon tube applicator attached to bite blocks.

CONCLUSION

Adequate treatment of tumors often results in a change in the contour of tissue from normal or in the actual destruction of tissue. If this occurs on a portion of the body such as the face or in the oral cavity, it immediately becomes apparent to everyone who is in contact with the patient. The patient is often affected adversely and usually shuns contact with others. His nutritional status may be affected and then he will suffer ill health. These unfortunate people can be helped by the dentist. The radiologist can also be materially assisted by the dentist in the treatment of cancer by constructing appliances which will help to protect normal surrounding tissue from the effects of roentgen rays.

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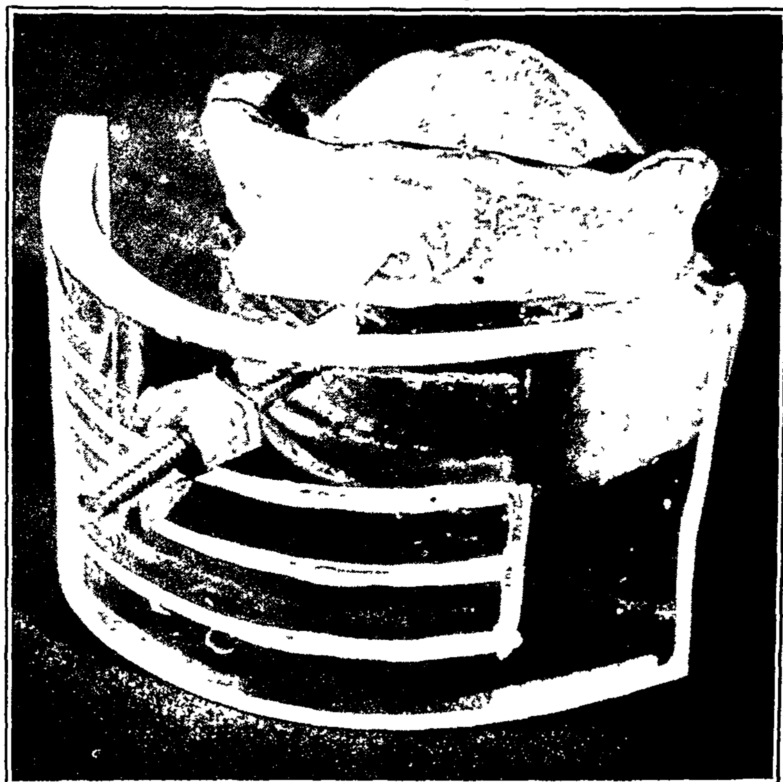


FIG. 18. Radon tube applicator attached to bite blocks.

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14

Responsibility of the Dentist

By this time it is common knowledge that cancer is the second greatest killer in the United States. Human beings, both lay and professional, because of its great publicity have almost begun to realize that this fact is not just taken from a mass of unmeaningful statistics, but that it is vitally true and concerns everyone regardless of race, color or creed. Cancer is no respecter of persons, whether rich or poor, whether they live in the finest environment or whether they live in the dirtiest of slums. It can truly be said that cancer is not a sectional or class disease.

Another very significant proved statement is that cancer is ever increasing. It has been said that the increase is a relative one; that is, the other conditions that have been listed as high in the list of killers of man have been reduced in their position by the various discoveries that have been produced by medical science in general The antibiotics certainly have played a most important role in the reduction of the fatal incidence of many of the infectious diseases. There is reason to expect that an even more relative increase of cancer will follow as the other fatal conditions are reduced. In the past, many died of diseases that today have been practically conquered with the antibiotics and chemotherapeutic agents. Many of these would have had a much greater chance of developing a condition of cancer if these new agents had been used at that time. Regardless of the etiology of this increase the fact remains that there is more cancer today than there has been in the past and the indications are that it will even rise to a higher figure.

Further considerations are that the treatment of early cancer is delayed because of the belief of many uninformed patients, even physicians and dentists, that cancer is an incurable disease. A Gallup poll reported in the April 9th, 1945, issue of *Time* magazine stated that 1 out of 4 citizens of the United States thinks cancer in any stage is incurable It is through this disbelief that the American Cancer Society has been formed. This organization was created in 1913 for the purpose of bringing the public interest to a focus on cancer through the medium of radio, newspaper and magazines.

This publicity has necessitated thorough knowledge of all persons engaged in health service to give prompt and efficient attention to patients suffering with this disease.

Concerning the belief that cancer cannot be cured, let us suffice to say that 80 per cent of the cancer cases are curable if the treatment is instituted in early stages. It may be added that in those cases in which the treatment is instituted late the cure in round numbers is about 20 per cent; therefore, it is absurd for any person to make a statement such as has been mentioned that cancer is a totally incurable disease.

It is the prime purpose of all organizations affiliated with the cancer problem to bring to the public the true facts about this disease and to especially disprove the aforementioned belief that cancer is incurable. We are especially aware of this fact in recent times since the current drive for funds for the American Cancer Society has never been equaled in magnitude before in any other attempt. This indicates a widespread interest of the general public in that so many research foundations are today being built throughout this country. There is no doubt that due to the stimulation of interest that has been evidenced in the cancer problem that in a very short time great strides will have been made toward the problem of cancer control in this country.

Early diagnosis is of supreme importance. Certainly the recognition of many external lesions as being abnormal may be provided by the laymen themselves, but a great number of malignant growths that prove fatal are those of internal or semi-internal origin or habitat. It is significant that these insidious lesions exhibit a minimum symptomatic response; therefore, it is obvious that the early diagnosis of the majority of malignancies must be done by trained professional personnel. It may be added that cancer differs from other diseases in that it is not an inflammatory process and does not exhibit any of the inflammatory responses that serve as a warning to the individual that something is wrong It may be stated, however, that cancerous lesions may become secondarily infected and produce symptoms thereof. In the light of the above written statements all members of the healing arts profession have a duty, obligation and responsibility to all of the public in recognizing any suspicious lesion or manifestation that may be potentially a malignant growth.

Certainly the dentist has a great responsibility in the diagnosis of suspicious oral lesions It is coming to light that the diagnosis of oral malignancies is truly the duty of the dentist more so than anyone else. Dr. Martin, attending surgeon at the Memorial Hospital

in New York, made a survey of patients with cancer of the mouth and found that out of each 100 cases examined the following had consulted a dentist before consulting a physician:

Site of the Cancer	*Percentage of Patients Consulting a Dentist Before a Physician*
Gum	59
Hard Palate	35
Buccal Mucosa	22
Tongue	21
Floor of Mouth	20

It must be pointed out, however, that this chart refers to persons or individuals who had already noticed that something abnormal was present. Perhaps the dentist may have had the chance to diagnose many more than this chart indicates had he been looking for insidious lesions. From the chart, however, it can readily be seen that a large percentage of cancer patients consult their dentist before they go to a physician. It is evident then that the dentist should ever be conscious of this fact and take every advantage of it in securing the early diagnosis so badly needed for a cure.

Twenty-five per cent of all cancers including those of the mouth occur on the head and neck. Of these, 34 per cent are skin lesions with cancer of the tongue, lip, salivary glands, extrinsic larynx, tonsil, intrinsic larynx, gingiva, floor of mouth, soft parts of head and neck, paranasal sinuses, nasopharynx, mucosa of cheek, palate, thyroid and parathyroid, pharyngeal wall, eye and associated structures, skull including tumors of dental origin, mastoid cells, middle and inner ear, and nasal cavity following in order of frequency. Cancer is second in the cause of death to diseases of heart and circulatory system. Since approximately two hundred thousand fatalities occurred in 1950 from all types of cancer and oral malignant lesions represent 7 per cent of all cancer, the responsibility of the dentist is to do all in his power to reduce the number of fatalities from this condition.

One of the practical achievements of the dental profession during the past few years is the established idea of periodic visits for oral examination. These twice yearly visits afford the opportunity for the general practitioner of dentistry which the physician does not usually have. The necessity for seeking medical aid at an early date has been stressed and it is the responsibility of the dentist to see the early signs of cancer and take adequate precautionary measures.

It is not expected that the general practitioner be thoroughly familiar with the treatment and the clinical course of all neoplastic growths, but it is his responsibility to keep abreast of the times and be familiar with the basic principles of cancer manifestations. As pointed out by Martin, "There should be cooperation between the dental and medical professions in the fight against cancer". It would be well if dentists and physicians met routinely and discussed their related cases as well as a mutual exchange of knowledge and experience related to cancer. Moreover, it would be better if the dentist should become the number one authority on oral cancer. Every dentist should strive toward the end of becoming such an authority so that he would be accepted whole-heartedly in any discussion of oral cancer in any professional group.

The dentist is in a strategic position to detect these precancerous and cancerous lesions of the oral cavity and the adjacent tissues. An estimated 10 per cent of all malignant neoplasms in men and 2 per cent in women occur in the oral cavity. The U. S. Report on Vital Statistics reported that 5,012 persons died in 1939 because of intra-oral cancer. In 1947 cancer of the mouth developed in approximately 20,000 persons

When we consider that 62 per cent of all mouth cancers seen by the dentist first were not recognized, we realize the importance of this discussion. Loss of time in treatment is critical. Any delay that is caused as a result of professional negligence in diagnosing the early lesion produces a responsibility for the death of the individual that cannot be cast aside lightly.

This brings us to the question of how the dentist may better himself in preventing such needless oversight. When we realize that cancer is second only to heart disease in the cause of death, the seriousness of the cancer problem at once impresses us with the need of further study and research. As yet the primary causes of malignant tumors are unknown but we must keep abreast with all new data that is pouring out so rapidly.

It has been said that one of the greatest shortcomings of both the dental and medical professions is the incompleteness and haphazardness in examination of the patient. The general tendency is to examine only the area of complaint and to ignore the rest. Many of the patients present themselves for a periodic check-up, this means that they are putting their confidence in us to recognize any abnormal conditions in or around the mouth. If our examination is incomplete and we should overlook some growth which may be malignant it would certainly put us in a precarious position. We are not only hurting ourselves but are endangering the lives of our

patients because the responsibility is ours to give them the service they seek and are entitled to.

To be able to prevent or detect a cancerous lesion, we must know something about its etiology and symptoms. From our present knowledge it would seem that cancer of the mouth is caused by some form of irritation in the presence of infection in some susceptible tissue. Blair states that the majority of all cases can be traced to leukoplakia or some local irritation, and that syphilis is thought to be the strong predisposing factor.

The irritation necessary to produce carcinoma may be from smoking or the use of tobacco in any form, carious and sharp defective teeth, impacted teeth, trauma, mechanical irritations from artificial bridges, fillings, plates and other restorations, mechanical irritations from food in open contacts or unprotected tissue, and chemical irritations from drugs As carcinoma is more prevalent in the mouth of men than of women, the use of tobacco would seem to be an important type of irritation. Other factors may be heredity, misplaced embryonic cells, occupational predisposition, food, and improper elimination.

We must have an understanding of the appearance of cancer in the mouth in order to be able to know what we are looking at when we do encounter it in the mouth. Early cancer of the oral mucous membrane is characterized by a small indurated plaque or ulcer, which infiltrates the tissues in which it arises. The most common precancerous lesion of the mouth is leukoplakia. Transition toward malignant tendencies is marked by chronic fissure, ulceration, a reddish elevated papule, or hardness of the tissue surrounding the leukoplakia.

Leukoplakia may be found on the cheek, tongue, lips, or palate. A hasty, careless oral examination may let pass unnoticed patches on edentulous ridges or underneath the tongue. The fact also that it is painless favors the chances of its being unnoticed by the patient. The patches are irregular and sharply outlined. They may be colored milky or grayish-blue. It is agreed by many that the chief cause of leukoplakia is smoking. The degree of severity of the patch is usually in proportion to the manner in which tobacco is used and its frequency, such as with chewing tobacco, pipe, cigars, and cigarettes.

The duty of the dentist in treating such a lesion, in addition to correction or removal if possible, would consist of informing the patient of his condition and discouraging the use of tobacco, spices, alcohol, condiments and any other agent or habit which may prove to be irritating. Some leukoplakia may be eliminated by electro-

surgical dissection or cautery if the area is small. The response to radium or x-ray is rare Leukoplakia should always be under close observation.

It is significant that in some cases mild leukoplakia may be reduced by simple massage with a soft rag and castile soap. This procedure should be tried for five-minute periods twice a day. This has proven to be helpful in reducing the hyperkeratotic lesion.

It is certainly a proven fact if every dentist would consider seriously the lesion of leukoplakia and be able to recognize it he would have done a great deal in the control of cancer Perhaps it may be said that the greatest responsibility of the dentist in the field of cancer is the recognition and correct diagnosis of the lesion of leukoplakia. This is significant when conservative figures place 20 to 30 per cent of the cases of leukoplakia among those which will develop into malignant lesions. Much has been written about descriptions of leukoplakia in order to aid the practitioner in diagnosing the condition; but the best and quickest way to learn to make the identification is to observe the lesion. Many such clinics are held and they offer an excellent opportunity for the general practitioner to see numerous lesions at one meeting The practitioner owes this to his patients. These clinics are of special advantage to the older practitioners who have not had the advance training that is now available in the field of cancer.

A good diagnosis of leukoplakia is the use of Lugol's solution. When applied to healthy tissue it stains a deep brown, but has little effect on leukoplakia due to the decrease of glycogen content of the tissue.

In this section of discussion of leukoplakia, it is necessary to mention that there are several conditions that may be mistaken for leukoplakia. The secondary lesions of syphilis (mucous patches) are easily confused with this condition, biopsy and one of the syphilis blood tests, such as the Wassermann, Kline, or Kahn, is the best way to differentiate these lesions. It must be remembered that it is not uncommon to find both lesions and too, the syphilitic lesions are known to be precancerous in many cases.

The fact cannot be overstressed that biopsy is the only true way to diagnose precancerous lesions. The procedure that should be followed in this will be discussed further later in this chapter.

When the growth occurs on a fixed or relatively immobile part, pain and tenderness may be absent for a period of weeks after the discovery of the lesion by the patient himself. In more movable structures of the mouth such as the anterior portion of the

tongue, the floor of the mouth or the cheek, pain may be an early symptom.

The usual cancerous ulcer of the mouth is coarsely glandular and shows less evidence of infection and inflammation than do the benign lesions. In mouth cancer the surrounding mucous membranes commonly exhibit signs of long standing chronic irritation in the form of atrophy, chronic glossitis and leukoplakia. As it progresses, ulceration and deep infection become apparent, accompanied by secondary infection and only at this stage do pain and disability become marked.

When cancer is present in the mouth any enlarged lymph nodes in the neck and face can be discovered by palpation. Cancer of the tip of the tongue or anterior part of the floor of the mouth will cause enlargement of the submental nodes. Cancer of the mandible and border of the tongue will affect the submaxillary nodes, but when situated farther back the superior deep cervical nodes will be first invaded.

Of the cancerous lesions, squamous cell carcinoma is of particular interest to the dentist because of its frequency of occurrence. It is one of the most common type malignant growths seen

In attempting to diagnose this cancer it is well to know that there are many varieties of squamous cell carcinoma and these may also be complicated by secondary infection and trauma.

There are two main types: the papillary type and the ulcerating type or infiltrating type Bernier states that there are many transitional forms and consequently it may be difficult to say one is papillary or definitely of the infiltrating type. The growths are most often seen on the vermilion border of the lip

The papillary type in its early stages gives the appearance of a slight thickening of the epithelium of the lip with slightly elevated edges. The base of these papillary types lies below the epithelium, the external portion gradually becoming necrotic sloughs out leaving an ulcerated appearance. Later it may form a crust over the superficial portion.

The infiltrating type usually begins as an epithelial thickening without peripheral elevation. The lesion then forms a scaly top which may be slightly raised. These lesions usually assume an ulcerated form earlier than the papillomatous type — sometimes even being ulcerated from the beginning. These ulcers are usually round or oval in shape and present ragged outlines Secondary infection is more apt to occur in the second type than in the first.

cutaneous portion of the lips and their line of closure anteriorly by the border line between the transitional and cutaneous portion of the lips and posteriorly by the line along which the lips meet.

The simple ulcer should be suspected until proven otherwise. The dentist should never overlook simple inflammatory ulcers due to dental trauma from jagged surfaces of the teeth which may occur on the tongue or the cheek. In many cases there is a history of sudden onset due to biting the tongue or cheek, acutely painful symptoms, and healing within a week or ten days. If these lesions do not heal properly, cancer should be suspected. Any mouth cancer may result from an ulcer that does not heal in two weeks under conservative treatment.

Tuberculosis ulcers of the oral mucous membranes occur by secondary implanting of the bacilli from the sputum of a patient with pulmonary tuberculosis. These ulcers are usually painfully tender and are an unhealthy yellowish color. Confirmation of a biopsy of such ulcers is obtained by chest *x*-rays and sputum examinations. However, in some cases, both tuberculosis and cancer have been known to exist in the same lesion, just as have syphilis and cancer.

Apical abscess must be differentiated from cancer of the jaw. It is often easily diagnosed with *x*-ray. When such abscesses become large and fluctuant, they resemble cancer of the gum or the maxillary antrum. If the *x*-ray shows marked destruction of the bone of the antral wall, cancer is strongly suspected. If the dentist feels that the extraction of teeth or that incision and drainage is indicated, he should first take caution by submitting a fragment of the tissue for biopsy. Frequently, pieces of tissue for biopsy can be obtained by scraping fragments adherent to the dental root.

Radiculodental cysts may vary in size from a few millimeters to several centimeters. Such cysts are benign. When a cystic tumor of the mandible or maxilla can be shown by *x*-ray to be multilocular the lesion is probably adamantinoma or a neoplastic growth which is incapable of cure by simple curettage Currettage of a primary malignant growth releases the growth from its restraining bony walls and allows it to spread to the tissues

Some of the benign lesions that a dentist will encounter are hemangioma, lymphoma, retention cysts and fibroma; all of which the average dentist should be familiar with and which should not be difficult to diagnose.

The greater number of growths in the mouth are in the benign class, but since all benign tumors are potentially malignant, they must be dealt with scientifically and thoroughly.

The dentist should realize that cancer of the mouth is usually painless in the early stages. A fact that we should not forget about cancer is that it tends to be symptomless. This has been mentioned before in this chapter but it is of utmost importance in the consideration of the responsibility of the general practitioner. When pain does become evident, the prognosis, unfortunately, becomes very bad as a rule.

It is well to consider the difference between a benign and malignant lesion. Again let us point out that the biopsy with microscopic examination is the only infallible way to differentiate the two.

The benign tumor is usually encapsulated to some extent. The blood supply may be said to be less than that of malignant types. As a rule, a benign tumor grows slower and does not infiltrate the surrounding tissues. The fact that it is encapsulated produces a relative motility on the surface. A benign lesion never involves the regional lymph nodes by metastasis, nor does it metastasize at all. Such lesions are seldom ulcerative. It can be said that a benign lesion does not interfere with health or destroy life unless it interferes in a mechanical way. An important difference is that when a benign lesion is completely removed, it does not recur. Benign lesions grow outward. They may be primarily multiple. A most important factor in the microscopic diagnosis is that they are homologous and typical; being similar to the tissue from which they are derived. They are usually hard and dry except the myxoma, which obviously would not be dry.

The malignant tumor is definitely not encapsulated. The blood supply is more abundant than that of the benign type. Malignant tumors grow very rapidly as a rule. They do infiltrate the surrounding tissue. When palpated, they usually are not movable. When they metastasize, they involve the regional lymph nodes. They are practically always ulcerative. They will impair health and eventually destroy life if left unattended. It is difficult to keep them from recurring even after careful removal. They usually grow inward and infiltrate the surrounding tissues. Unlike the benign, they are never primarily multiple except melanotic sarcoma. The microscope reveals the major diagnostic factor; that of being heterologous and atypical. The consistency is usually soft and juicy.

The malignant types of the soft tissue lesions of the mouth are sarcoma, certain types of mixed cell tumors, endothelioma, carcinoma and teratoma.

Anatomically, cancer of the mouth presents a different picture from that of cancer of other parts of the body. In other body

organs, malignant tumors seem to metastasize early and quite extensively. Mouth tumors rarely form remote or secondary tumors except in the terminal stages. Tumors of the mouth rarely extend beyond the clavicle and if the tumor is located on one side of the median line of the head, it will usually involve only the glands on the same side.

It is unfortunate that so many general practitioners do not know how to discuss cancer intelligently. There is a lack of familiarity with the terms that have been standardized. It would be well for every practitioner to have a good scientific knowledge of tumors, including the nomenclature, so that he may be able to project intelligently the subject matter to patients as well as discuss it with his professional colleagues. It is the job of everyone to spread the knowledge of cancer.

Having considered the clinical aspect of mouth cancer, let us now consider specifically what the dentist is expected to do in cancer control.

The specific point of this chapter and the most outstanding thought that is wished to be conveyed is that by careful observation of any suspicious lesion in the oral cavity of each patient under his care, the dentist may decipher the presence of a cancer before it has grown beyond the possibility of cure. Among the preventable cancers it is estimated that the most preventable are those found in the mouth.

Most men accept the Virchow theory of irritation as the most acceptable etiology of cancers that occur in the mouth. Badly decayed teeth with projecting jagged edges against which the tongue and mucous membranes of the cheek and lip are constantly rubbing act as chronic irritants. From the point of being a chronic focus of infection and also being an irritating factor on mobile teeth, pyorrhea may also be responsible for neoplasms, especially in the floor of the mouth.

Faulty dental restorations are often factors in the etiology of cancer because they are sources of extrinsic irritation. This is particularly true of partial and full dentures which are poorly made, and, as a result, fit poorly causing irritation. They produce constant irritation in rubbing against the mucous membrane of the palate, lip, cheek, and gingiva, of the supporting teeth.

The placement of dentures over a mild leukoplakia may, in some cases, be advantageous in causing its resolution, provided it covers the entire area. The reason for this is that the denture offers a cover for the area and removes it from the field of irri-

tation. This is especially true in cases of an etiological factor of smoking, or occupational irritation.

Definite sources of irritation also are fillings, inlays and crowns which have excessive and sharp margins pressing against the gingiva and interproximal papilla. Strong medicaments such as silver nitrate on benign lesions may result in definitely malignant lesions. As a general rule, it can be stated that any suspicious lesion should be removed from any site of irritation rather than using caustics on it.

Until such time that more knowledge is gained about cancer, the general practitioner must rely upon recognition of etiological factors in cancer production, precancerous conditions, and early diagnosis of the actual malignant lesion as his principal means of combating the disease. In order that he may successfully accomplish this, he should conscientiously carry out a strict routine on all of his patients, particularly the new ones. A suggested routine by Caldwell is described as follows:

1. He should completely and thoroughly examine all of the tissues of the oral cavity and its adjacent structures
2. He should consider all abnormal lesions or tissue growths potentially dangerous until proven otherwise.
3. He should consult qualified men in special fields of surgery and dentistry if a correct and early diagnosis is to be made.
4. He should take a biopsy of all abnormal tissue growth for pathological examination if there is any indication of a morbid change.
5. He should eliminate all chronic irritants from the oral cavity whenever and wherever they are found
6. He should impress upon his patients the importance of periodic examinations, particularly those patients who have passed forty years of age, and are wearers of artificial dentures.

The biopsy technique should be known by every practitioner of dentistry and medicine. The biopsy is extremely important in recognizing cancer in the early stages Because of a lack of appreciation as to its importance and a mistaken attitude of its difficulty, it is not used as extensively by general practitioners as it is desired.

There are various methods of taking a biopsy for microscopic study. The accepted methods are as follows.

1. Incision
   (*a*) scalpel
   (*b*) electrocautery
   (*c*) high frequency cutting current
2 Punch biopsy

3. Curettage
4. Paracentesis – for the examination of fluids, such as ascites and pleura for tumor cells.
5. Aspiration

Excision of the entire lesion is sometimes the best method of obtaining tissue for microscopic study. This is especially true when the lesion is small and, also, when the lesion presents itself as a papilloma. The narrow base of the papilloma can be excised with a sharp blade of a scalpel or removed by the use of waxed silk. The silk string is tied around the base of the lesion and tightened until the lesion is removed. This technic is simple to perform and furnishes the pathologist with the entire lesion.

In providing the pathologist with a tissue specimen for microscopic examination, Dingman suggests that the following rules be observed:

1. A representative region is chosen from which the biopsy specimen is to be obtained. This should be the region of the lesion which represents the greater portion of the entire pathological picture.
2. Thin, deep sections should be removed, rather than broad shallow sections. The broad, shallow section of tissue simply may show hyperkeratosis or inflammatory reaction without actually showing the presence or degree and extent of invasion of the tumor cells in the depth of the lesion.
3. Normal and abnormal tissues should be included in the biopsy specimen. To accomplish this, the specimen should be taken through the margin of the lesion.
4. An elliptical shaped section generally is desirable. The incisions are made vertical to the plane of the mucosal surface or converging to give a V-shaped section.
5. Crushing or mutilation of the specimen should be avoided. Special caution should be observed in handling the specimen with forceps.
6. Care should be taken not to include crust or sloughs from the lesion as biopsy specimens. These give inconclusive material for study and do not show representative sections of the neoplasm.
7. Specimens should be taken from more than one area of the tumor, if it appears different in character in these regions. A small drawing of the lesion should be made, and each specimen should be placed in a separate bottle and labeled to represent the area from which the specimen has been removed.
8. All biopsies in the region of the oral cavity should be cut deeply in order to show basal tissues.

9. When electrocautery or the high frequency cutting knife is used, care should be taken not to destroy the character of the cells by heat or dehydration.

10. After removal of a section of tissue, it should be placed in 10 per cent formalin (4 per cent formaldehyde). The section should be placed in the solution. Under no circumstances should the specimen be placed in the dry container before application of the solution to it. This provides an opportunity, particularly with small sections, for dehydration of the tissue and sticking to the side of the container. The solution should be in the container and the specimen dropped into the solution.

11. In the case of small lesions, the entire lesion should be removed for study rather than a small portion of the lesion.

12. All specimens should be labeled carefully and identified with the patient's name, address, occupation and age.

13 The pathologist should be provided with a short history of the development of the lesion and a brief statement of the locality from which the lesion was obtained. Inadequate information makes it difficult and time consuming for the pathologist and may lead to an inaccurate evaluation of the material submitted.

In the foregoing paragraphs it has been attempted to bring out the practical points that the average dentist can utilize to detect and prevent a large portion of oral cancer. From all statistics it seems that this disease is increasing each year. This may be due to one or two things: the fact that the lay people as well as the dentist and medical profession are more conscious of it, therefore, more cases are apt to be diagnosed, or due to an increase in the use of certain irritants such as tobacco and alcohol, which may be increasing its prevalence.

In either case the dentist of today should consider this disease as part of his dental practice, and with the present facilities and material at hand, he should endeavor to increase his knowledge on the prevention and detection of it It is certainly true that until a definite cure is found, many people will continue to die each year. It is the job of the dentist as well as others to keep the death rate from oral cancer as low as possible.

Some dentists fail to recognize cancer because of their reluctance to venture beyond what is erroneously considered to be strictly a dental field. Some dentists would not consider suggesting to a patient that he or she may have a cancer, this of course is due to the lack of education Many dentists fail to recognize cancer because they have had little or no training concerning the symptoms of early cancer and the importance of early diagnosis. It may truly be said without fear of contradiction that the first responsibility of

the dentist is to learn some of the facts concerning cancer. This is foremost, because it is foolish to think of diagnosing without some knowledge of the condition. Many have reason to regret their lack of training in the field of oral cancer when a patient they have been treating is later found to be suffering from cancer. In such cases, early recognition of the lesion would have greatly increased the chance of cure. The time has come and now the general public greatly depends on the dentist to make the diagnosis of oral cancer and holds him responsible if such is not done.

In summary it can be stated that the dentist must realize that he must be responsible not only for the dental organs alone but it is his responsibility to care for all of the oral cavity and its associated structures. If the approximately eighty thousand dentists in the United States will be especially vigilant in examining the thirty-five million they see each year and adhere to the rules listed herein they can do much to win this ever increasing fight against man's second greatest killer today, cancer.

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15

Review of the Study of Cancer

In approaching the problem of cancer, we are faced with the seeming paradox that, although our present day knowledge is gradually increasing concerning cancer, so is the mortality rate. Sixty-eight and seven-tenths persons died per 100,000 per year from 1901 to 1905. In 1938 one hundred and fifteen persons per 100,000 died of cancer. This problem confronting the profession of the healing arts is therefore becoming imperative, and this in the face of extremely fragmentary knowledge and facts of the disease makes it necessary that research be continued. Until these facts have been found, treatment must necessarily remain empirical and therefore the efficacy of methods employed frequently remains controversial.

Since cancer has been increasing in frequency, the control of it is no longer a matter of personal relationship between the physician and the patient. During the past twenty-five years it has become a public health problem of first magnitude. Statistical studies on the trends of the mortality curves by life insurance companies indicate that it will become the most important of all public health problems.

Cancer control requires the equipment and facilities of the modern hospitals. It receives constant cooperation of the organized medical profession. It relies on the lay and medical presses. It enjoys the generous support from philanthropists It progresses with all the medical sciences It has aroused a sense of opportunity and responsibility in public health organizations, local and national, all over the world.

There are many questions concerning cancer that have been answered by the modern medical sciences and many more that are still unanswered Some of the questions that we can answer are these:

Q. *What is a neoplasm?*

A. A neoplasm is an overgrowth of cells which are independent of normal growth controls It serves no useful purpose, and is often injurious to normal tissue.

It is a non-inflammatory, relatively functionless local growth of new tissue, consisting of cells and matrices of types normal to the body, but atypical in location, form, arrangement, development, and mode of growth, with a tendency to degeneration and necrosis and of unknown etiology.

Q. *Define malignancy.*

A. This is a mass of cells arising from and continuing to proliferate within an organism as a result of and in direct proportion to the extent of their internal qualitative differences from the other cells of the organism with respect particularly to the potencies of differentiation and organization. Further, these qualitative differences are established before determination takes place, hence in spare parts composed of undifferentiated protoplasm.

Q. *Is there a continuous repair of tissue which follows injury and the normal wear of the organism?*

A. Yes, these tissues are continually being repaired and replaced.

Q. *Which cells in an organism are more easily replaced?*

A. Those which are least highly organized and differentiated in function and in structure: for example, renal glomeruli and ganglion cells of the central nervous system are hard to replace.

Q. *What is hypertrophy?*

A. This is the increase in size of an organ or cell.

Q. *What is hyperplasia?*

A. This is an increase in the number of cells or component parts from which an organ is made.

Q. *What is metaplasia?*

A. This is the change from one type of cell to that of another.

Q. *What is the cause of metaplasia?*

A. Chronic inflammation, irritation, impairment of nutrition and function or demand for altered function.

Q. *What is anaplasia?*

A. This is a reversion or a transformation of cells into a more primitive embryonic or undifferentiated type.

Q. *What is a benign tumor?*

A. One which grows slowly and expansively, and unless it is in some vital spot or interferes with an important organ it is well tolerated. It does not necessarily interfere with the well-being of the organism or shorten its life. It is composed of a well differentiated mature type of cell.

Q *What is a malignant tumor?*

A. One of a more rapidly growing type, will infiltrate and extend into normal structure, and unless effectively treated it will interfere with health and eventually cause death. It is usually com-

posed of a more embryonic type or poorly differentiated type of cells.

Q. *How are neoplasms classified?*

A. They are classified as to structure and origin.

Q. *Classify tumors as to structure and origin.*

A. (1) Tumors of mesenchymal origin
  a. benign
  b. malignant—sarcoma
(2) Tumors of epithelial origin
  a. benign
  b. malignant—carcinoma
(3) Mixed tumors and teratomas
  a. benign
  b. malignant

Q. *What tumors are classified in the mesenchymal group?*

A. Fibroblastic, cartilage, bone, fat, blood vessels, lymphatic tissue, mesothelium, muscle and blood forming tissue.

Q. *Is there a sharp line of demarcation between benign and malignant tumors?*

A. Often no sharp line of demarcation separates benign and malignant tumors. Differences are often a matter of degree. Borderline cases are quite common and often difficult to classify.

Q. *What is the comparison of the sizes of nuclei and nucleoli in malignant and non-malignant cells?*

A. It has been noted that malignant cells have nuclei and nucleoli of larger average size than in corresponding non-malignant cells.

Q. *What are the characteristics of malignant cells?*

A. (1) Lack of polarity
(2) A wide variation of nuclear and cytoplasmic structure
(3) A decrease in structural differentiation and specific functional activity
(4) A lesser dependence on oxygen supply
(5) A decrease in organism control over cell division and increase in invasiveness and ability to outlive cells of invaded tissue

Q. *What are the factors which must be considered in estimating the result or prognosis of a tumor?*

A. (1) Type of tumor
(2) Its location
(3) The duration, size, spread and presence or absence of metastasis
(4) The age and condition of the patient

(5) The rate of clinical growth
(6) The histologic structure
(7) The radiosensitivity of the tumor

Q. *How do the effects of x-ray and radium compare in the treatment of tissues?*

A. The effects are similar.

Q. *What rays are in use in the therapeutic work on tumors?*

A. Only the gamma rays.

Q. *How are the alpha and beta rays excluded in the work?*

A. The alpha and beta rays are excluded by screening.

Q. *What types of cells are more sensitive to irradiation?*

A. Cells which are actively proliferating or cells which are of a primitive type are more sensitive than normal tissue.

Q. *What are Warren's 3 groups of tumors according to radiosensitivity?*

A. (1) Radiosensitive tumors—those which regress or clinically disappear with a dose of 2,500 roentgen units or less, usually without appreciable damage to adjacent normal tissue.
(2) Radioresponsive tumors—those which require 2,500 to 5,000 roentgen units for similar regression. Adjacent normal tissue shows definite reaction to this dosage, but without permanent injury.
(3) Radioresistant tumors—those which require over 5,000 roentgen units for response. Damage to normal tissue may equal or exceed that done to the tumor.

Q. *How do tumors metastasize or spread?*

A. (1) Direct invasion growth into surrounding tissue
(2) Extension by lymphatics
(3) Extension by blood stream
(4) Extension by implantation

Q. *What is the most common method of spread of carcinoma?*

A. By the lymphatics.

Q. *What is the most common method of spread of sarcoma?*

A. The blood stream.

Q. *At what sites are the secondary tumors that metastasize through the blood?*

A. Liver, lungs and bone mainly.

Q. *What is the immediate cause of death in malignant tumors?*

A. Pulmonary disorders such as pneumonia. Embolism, abscess, atelectasis and cachexia. The latter mentioned appears to be the most frequent single cause and is particularly common with cancer of the breast, stomach, and colon. Renal failure is common with

carcinoma of the cervix, bladder and prostate. Tumors of the alimentary tract may cause death by obstruction. Intracranial tumors cause death by pressure effects within the rigid casing of the nervous system.

Q. *What are the chief advances of experimental cancer research in the immediate past?*

A. (1) Certain tumors are transplantable from animal to animal within a given species.
(2) Malignant tumors can be initiated by the use of carcinogenic agents.
(3) Certain tumors such as the chicken sarcoma of Rous can be transferred by means of a cell free filtrate or extract and are apparently of viral etiology.

Q. *Give a histo-pathological classification of tumors.*

A. I. Epithelial tumors
- A. Benign
  - (1) Papilloma
  - (2) Adenoma
  - (3) Ameloblastoma
- B. Malignant
  - (1) Squamous-cell carcinoma
  - (2) Basal-cell carcinoma
  - (3) Adenocarcinoma
    - (a) Mucoid carcinoma
    - (b) Scirrhous carcinoma
    - (c) Carcinoma simplex

II. Connective Tissue Tumors
- A Benign
  - (1) Fibroma
  - (2) Lipoma
  - (3) Neurofibroma
  - (4) Myxoma
  - (5) Chondroma
  - (6) Osteoma
  - (7) Myoma
  - (8) Lymphoma
  - (9) Angioma
    - (a) Hemangioma
    - (b) Lymphangioma
- B. Malignant
  - (1) Fibrosarcoma
  - (2) Lipoma
  - (3) Neurogenic sarcoma

(4) Myxosarcoma
(5) Chondrosarcoma
(6) Osteogenic sarcoma
(7) Myosarcoma
(8) Lymphosarcoma
(9) Angiosarcoma
(10) Undifferentiated sarcoma
(a) Spindle-cell sarcoma
(b) Small round-cell sarcoma
(c) Large round-cell sarcoma
(11) Mesothelioma

III Mixed Tumors
A. Benign form
B. Malignant form

IV. Teratomas
A. Benign form
B. Malignant form

Q. *What is a fibroma?*

A. A mesenchymal tumor derived from and composed of fibrous connective tissue. It is of wide distribution.

Q. *What is a keloid?*

A. This is an excessive formation of a fibrous scar resulting in a tumor-like mass resembling a fibroma. Certain individuals, particularly among the Negro race, are prone to this excessive fibrosis following injuries to the skin.

Q. *What is a lipoma?*

A. This is a benign, circumscribed mass of adult type of fat tissue.

Q. *What is a myxoma?*

A. It is a modified form of fibroma in which a mucoid intercellular substance separates embryonic connective tissue cells so as to resemble in appearance the tissue of the umbilical cord.

Q. *What is a myoma?*

A. This is a benign tumor of muscle tissue.

Q *What is an angioma?*

A. This is a tumor composed of endothelial cells tending to form blood or lymphatic channels.

Q. *What is a glioma?*

A. A tumor arising from neuroglia or supporting cells of the central nervous system.

Q. *What is a teratoma?*

A. A tumor containing organs or distinct fetal structures representing all three primitive layers of blastoderm. It is really an

attempt at development within one individual of another individual of the same species. It is derived from totipotential cells which are capable of differentiation into any organ or tissue, and which in the right circumstances and environment would develop into a complete individual.

Q. *What is the cause of cancer?*

A. The cause of cancer is unknown. Nevertheless, certain factors may be considered as contributing causes. There is a controversy relative to the importance of heredity. While many students of the disease believe that there is an hereditary tendency, just as many hold the opposite opinion. Cancer of the mouth occurs most frequently in males during the 4th and 5th decade. Some of the causes are thought to be irritation caused by smoking and chewing tobacco, heat and pressure from the stem of a pipe, rough and jagged teeth, ill-fitting dentures, restorations of dissimilar metals, poor mouth sanitation or long continued inflammations.

Q. *Differentiate between benign and malignant tumors.*

A.

Benign	*Malignant*
1. Grow slowly	1 Grow rapidly
2. Expansive growth	2. Invasive growth
3. Usually encapsulated	3. Not encapsulated
4. Do not recur after careful removal	4. Recur after incomplete removal
5. Do not metastasize	5 Do metastasize
6. Do not kill unless they compress vital organs	6. Do kill
7. Rarely show necrosis and ulceration	7. Often necrosis and ulceration
8. No cachexia	8. Cachexia and anemia
9. Consist of well differentiated cells	9. Consist of poorly differentiated anaplastic cells
10. Cells are rather uniform in size and shape	10 Polymorphism of cells
11. Nuclei take up stain normally	11 Hyperchromatic nuclei
12. Few mitosis	12 Numerous multipolar mitoses
13. Fairly good imitation of the arrangement of the tissue from which they are derived	13 Unsuccessful imitation of the tissue of origin
14. Cells do not infiltrate	14 Cells do infiltrate

Q. *How do tumors cause death?*

A. 1. By pressure upon vital organs.
2. By invading vital organs and causing degeneration.
3. By hemorrhage resulting from ulceration and degeneration.
4. By absorption of poisonous products formed by the destruction of tumor cells.
5. By exhaustion due to the tumor using up so much nutrition for its own benefit.

Q. *What is meant by precancerous lesions?*

A. The term is applied to those conditions which are known to become malignant. These are pathologic conditions which in themselves are not malignant but which may develop into malignancy.

Q. *What is Virchow's theory of tumor formation?*

A. Virchow's theory, the mechanical irritation theory, states that new growths arise in tissues that have been the seat of injury or chronic irritation. Certain cases seem to uphold this theory, such as epithelioma of the lower lip of pipe smokers and carcinoma of the gall bladder associated with gallstones.

Q. *What is Cohnheim's theory of tumor formation?*

A. This is the embryonic rest theory. He believed that in early stages of embryonic development more cells were produced than were required for the formation of the tissue involved so that there remained unused a number of cells which on account of their embryonic character were endowed with the power of marked proliferation. He thought that they could lie latent for many years and develop later in life if conditions should become favorable.

Q. *What is the relation of mortality of cancer between the poorer and more wealthy people?*

A. Cancer mortality is lowest where conditions of life are hardest, the surroundings the most squalid, where the tubercle mortality is highest, the general and infantile mortality greatest and where sanitation is least favorable, in short, among the poor of the industrial class of our great towns; whereas among the wealthy and well-to-do, where the standard of health is at its best and life is easiest and where conditions are the reverse of the foregoing, the mortality is the highest.

Q. *Can cancer be cured?*

A. Yes, many types of cancer can be cured if discovered early and treated promptly.

Q. *Is cancer contagious?*

A. No. There is no danger of catching cancer by coming in contact with a person who has such a lesion.

Q. *Is cancer inherited?*

A. No. But it may be that in some families there is lowered resistance on the part of certain tissues or organs to the factors which favor development of cancer.

Q. *Is cancer infectious?*

A. No.

Q. *Is cancer caused by a microorganism or parasite?*

A. No.

Q. *Is cancer wholly due to local injury?*

A. No.

Q. *Does cancer appertain to any particular occupation?*

A. No.

Q. *Does cancer affect all sexes, races and classes of people?*

A. Yes.

Q. *Is cancer confined to any location or section of the earth?*

A. No.

Q. *What is the first principle in the treatment of cancer?*

A. It is the recognition and knowledge of the difference in response of cancer to treatment in its early as compared to its late stages.

Q. *How is the differential diagnosis made?*

A. Only by biopsy and microscopical tissue examination.

Q. *What are the methods of obtaining tissue for microscopical examination?*

A. 1. Incisional: scalpel, cautery, or radio scalpel
   2. Various punch methods
   3. Curettage
   4. Paracentesis for the examination of fluids for tumor cells
   5. Aspiration

Q. *How is aspiration biopsy performed?*

A. It consists of withdrawing cells from a human through a large bore needle under strong suction.

Q. *What are the reactions to excess radiation in treatment of tumors?*

A. 1. Odd taste
   2 Nausea and vomiting
   3. Edema
   4. Erythema
   5 Radiation ulcers and necrosis
   6. Epidermitis

Q. *What is a treatment of local reaction to excess radiation in treatment of cancer?*

A. 1. Application of calomine lotion or ointments containing anesthetics.
2. Tannic acid jelly for denuded areas.
3. In late radiation ulcers, hypertonic magnesium sulfate solutions are of value in combatting secondary infection and edema.

Q. *What do we mean when we speak of the quality of x-ray?*
A. We are referring to the wave lengths present.

Q. *What is hard radiation?*
A. Short wave length.

Q. *What is soft radiation?*
A. Long wave length.

Q. *What is a roentgen?*
A. It is a unit defined in 1928 by international agreement based on the absorption of x-ray energy in air. One roentgen produces in one cc of air roughly two billion ion pairs which will transfer an electrostatic unit of electricity.

Q. *What is the commonest of all visceral malignancies?*
A. Gastric carcinoma.

Q. *Who were the first men to produce malignant neoplasms on experimental animals?*
A. Yamagiwa and Itchikawa were the first to produce malignant tumors experimentally in 1915 by repeated application of coal tar on the ears of rabbits.

Q. *What is the aim of the surgical approach in the treatment of cancer?*
A. To remove by the most direct means every particle of the tumor and its assumed extensions.

Q. *How many deaths resulted from cancer in the U. S. in 1950?*
A. An estimated 210,000 persons.

Q. *Does cancer begin with a definite symptom or symptoms?*
A. More often the early symptoms of cancer are scarcely noticeable, there may be nothing more than a slight change from the normal.

Q. *What are the early warning signs of cancer?*
A. 1. A lump or thickening anywhere in the body, especially in the breast, lip, or tongue. Any change in the size, shape or position of the breasts.
2. Irregular or unexplained bleeding from the nipple, vagina, or any body opening, blood in the urine or stools.
3. A sore that does not heal, particularly about the tongue, mouth or lips.
4. Progressive change in the color or size of a mole, wart, or birthmark.

Q. *Is cancer inherited?*

A. No. But it may be that in some families there is lowered resistance on the part of certain tissues or organs to the factors which favor development of cancer.

Q. *Is cancer infectious?*

A. No.

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(1) Tests based on chemical changes
    (a) In urine
    (b) In blood
    (c) In body secretions
(2) Tests based on immunological pıinciples
    (a) In urine
    (b) In blood and tissues
(3) Tests based on enzymological pıincipals
    (a) In urıne
    (b) In blood

'n what group of women is cervical cancer most prevalent?

Cervical cancer is a disease of childbearing women and is preceded by cervical lacerations and irritating cervical

.

What constitutes a diagnosis of cancer and by what means be accomplished?

A diagnosis may be said to have been obtained when the .n has been placed in command of data which will enable understand the origin, course and prognosis of the case d. This information must include the results of the physical ıation of the patient, roentgenogıaphic study, and histostudy, which reveal the structure of the tumor, the origin tumor, its grade of malignancy, and the grade of radiovity.

What prophylactic care of the skin should outdoor workers) prevent precancerous lesions?

Frequent cleansing of the skin, wıth mild, nonirritating soap, copıous quantities of water and followed by the application S. P. cold cream three or four times daily. The precaution ›tecting the skin of a patient, who is predisposed to the denent of these lesions, by wearing a hat which will shade the ›r gloves to protect the hands, is obvious.

What are the advantages of completely removing a susd cancer lesion at the time of biopsy?

The surgeon is rendered a diagnosis of the tissue removed vhether the maıgins and depths of the remaining defect are letely free of further tumor invasions. The surgeon may then se the wound with minimal disturbance to the patient and n a satısfactory ıesult through healing which shows minimal and distortion. The patient's period of incapacity will be red to the smallest possıble time.

When should the surgeon repair the defect resulting from 'ion of a lesion?

5. Persistent indigestion, especially in persons over 40 years of age.
6. Persistent change in normal bowel habits.
7. Persistent hoarseness, sore throat, or difficulty in swallowing.

Q. *Name some of the radioactive isotopes now being used in the treatment of cancer.*

A. (1) Iodine is being used with dramatic results in about one out of five thyroid cancers.
(2) Phosphorous is helpful in some cases of leukemia.
(3) Cobalt serves as a good substitute for radium.
(4) Nitrogen mustard has been effective against lymphatic forms of cancer, particularly some forms of leukemias and Hodgkin's disease.
(5) Hormones help male patients with cancer of the prostate and some women with breast cancer.
(6) The pituitary hormone, ACTH, and the adrenal cortical hormone, cortisone, show promise for leukemic children.

Q. *What per cent of skin cancer can be cured?*

A. 95 per cent when diagnosed early
40 per cent of late cancer

Q. *What per cent of lip cancer can be cured?*

A. 90 per cent of early cases
15 per cent of late cases

Q. *What per cent of breast cancer can be cured?*

A. 90 per cent of early cases
Less than 25 per cent of late cases

Q. *Do chemicals cause cancer?*

A. Scientists have found that some 400 chemicals will cause cancer.

Q. *Does over exposure to the sun and weather cause skin cancer?*

A. Skin cancer among fishermen, sailors and farmers is quite prevalent, thus over exposure is believed to be a factor in causing skin cancer.

Q. *Is it possible to immunize a person against cancer?*

A. Possibly. Some animals can be immunized against some types of cancer.

Q. *What type of cancer is increasing more rapidly than any other?*

A. Lung.

Q. *Classify diagnostic cancer tests.*

treatment it tends to become raised, finely granular, or even papillary in texture and definitely palpable. Opacity usually increases with age, some lesions becoming cream-colored, gray, or yellow-tinged. Induration of this keratinized area may occur, and with it fissures may develop. Ulceration or flaking is not uncommon in more severe cases. Leukoplakia is significant as a precancerous lesion mainly because it indicates the existence of chronic irritation.

Q. *Why is squamous cell carcinoma of the lip of particular importance to the dentist?*

A. Squamous cell carcinoma of the lip occurs very frequently and an accurate clinical diagnosis is so essential in a condition with such a serious prognosis.

Q. *What is the treatment of choice among clinicians for squamous cell carcinoma of the lip?*

A. Surgical operation is the treatment of choice; second, is surgery and irradiation; and third, is irradiation.

Q. *How does metastasis occur in cases of squamous cell carcinoma of the lip?*

A. By way of the lymphatic vessels, the cervical and sub-mental nodes usually being the first affected.

Q. *What is the pathology of cancer of the floor of the mouth?*

A. In nearly all cases, a cancer of the floor of the mouth is a squamous-cell epithelioma. Sometimes, a transitional-cell epithelioma is found and, in rare instances, an adenocarcinoma developing from the salivary tissue may occur.

The lesion originates in the mucosa of the floor of the mouth, commonly around the orifice of the submaxillary duct on either side of the frenum, and rapidly extends to the undersurface of the tongue, to the gingival and buccal mucosa, and in some cases, to the lips. It is a slow-growing, but a rapidly invasive lesion, readily piercing the adjacent musculature of the floor of the mouth, and, at times even invading the jawbone. Its spread through the lymphatics is early, involving the sub-maxillary nodes, the superior and deep cervical nodes, and when the lesion is in the anterior portion of the floor of the mouth, the inferior deep cervical and the submental lymph nodes.

Q. *What is the prognosis of cancer of the floor of the mouth?*

A. The prognosis in cancer of the floor of the mouth is always grave. Moreover, in most instances, treatment is requested after the lesion is far advanced. As in carcinoma elsewhere, best results are achieved when the lesion is recognized early and radically treated at once.

Q. *List the precancerous lesions of the tongue.*

A. Theoretically one should wait for a period of two to five years but usually patients are unwilling to wait. Most surgeons make repairs within a period of 6 months to 1 year.

Q. *What are the most common sites of cancer in the mouth?*

A. Lips.
Mucosa lining the buccal cavity and covering the alveolar ridge.
Tongue.

Q. *What is the appearance of basal cell carcinoma of the skin?*

A. Basal cell carcinoma of the skin appears as a small nodule, and grows slowly. It ulcerates, becoming slightly raised, and forms a crust with a pearly appearance around its borders. Most authorities agree that it does not metastasize, but it invades and destroys the surrounding tissues.

Q. *What is the appearance of squamous cell carcinoma and how does it begin?*

A. Characteristically, this growth begins as a warty area, or in a region of chronic scaling of the skin It develops rapidly into an ulcer with indurated borders The base bleeds freely when the crust is removed and infection commonly occurs It metastasizes readily. Regional lymph nodes should always be examined carefully.

Q *What is the most common type of cancer in women?*

A. Cancer of the breast.

Q. *Do moles become cancerous?*

A. All do not, but they may undergo a malignant transformation, and develop into one of the deadliest and most rapidly fatal forms of cancer known—the malignant melanoma.

Q *What type moles comprise the dangerous group?*

A. The junction nevi, arising from the epidermal junction in the skin. These moles are small, relatively smooth, hairless growths, often present since birth. They are flat, or only slightly raised, and range in color from light brown to black. The junction nevus occurs most frequently on the hands, feet and genitals.

Q. *Should moles be biopsied?*

A. Benign moles and those suspected of being malignant should not be subjected to any form of biopsy but should be removed by delicate and often liberal surgical resection, followed, if proven malignant, by radiation.

Q. *What is leukoplakia?*

A. Leukoplakia is the most definite precancerous lesion of the tongue. It is a hyperkeratosis of the mucous membrane epithelium which usually appears as a sharply demarcated, slightly opaque, white patch. In early stages it is flat and not palpable, but without

treatment it tends to become raised, finely granular, or even papillary in texture and definitely palpable. Opacity usually increases with age, some lesions becoming cream-colored, gray, or yellow-tinged. Induration of this keratinized area may occur, and with it fissures may develop. Ulceration or flaking is not uncommon in more severe cases. Leukoplakia is significant as a precancerous lesion mainly because it indicates the existence of chronic irritation.

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Q. *List the precancerous lesions of the tongue.*

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(B) Syphilis
(C) Ulceration
(D) Lichen planus
(E) Fissures
(F) Warts, or any sore of the tongue

Q *Does carcinoma of the lip occur more frequently in men or women?*

A. There is an average of 93.3 per cent in men and 6.7 per cent in women, roughly a ratio of 14 to 1.

Q. *What is the treatment for a tumor of the salivary glands?*

A. The treatment is block dissection of the cervical nodes, especially of the posterior chain, and complete removal of the gland and such adjacent bony structures as may be involved Radiation therapy should not be attempted The prognosis is poor

Q. *Does radiation therapy affect tooth structure?*

A. In addition to the undesirable effects and frequent serious sequelae of cancer—lethal radiation on the alveolar process, radiation therapy may produce specific injury to the teeth themselves Often after an interval of months or even a week or two following radiation therapy, a chalky debilitation of the teeth in the field of radiation develops so that they chip and crumble always leaving irregular edges of knife-like sharpness There is no known remedy for such diseased teeth, but it is best to grind down the sharp edges and avoid wholesale extraction A second dental complication following radiation therapy for mouth cancer is persistent toothache in the teeth situated within the direct beam of radiation When these teeth are extracted, osteomyelitis usually results These complications are the principal reasons why cancer of the gum is preferably treated by surgery

Q *From what do secondary malignancies within the bone result?*

A. (1) Direct extension from contiguous primary cancer
(2) Direct extension from adjacent metastatic cancer in a lymph node
(3) Invasion along the inferior dental canal by way of the mental foramen
(4) Blood borne metastasis from the breast or thyroid or some other primary site

Q. *List the rules that should be kept in mind when taking a biopsy.*

A. (1) A representative lesion should be chosen from which the biopsy specimen is to be obtained. It is important not to

paint the area with any colored antiseptic which might interfere with the later staining of the tissue for microscopic examination.

(2) Thin deep tissue sections should be removed rather than broad shallow pieces since a broad shallow section of tissue might not show the evidence of invasion of the underlying tissues with the malignant cells.

(3) Since normal as well as abnormal tissues should be available for the pathologist, a specimen should be taken through the margin of the lesion.

(4) The excised tissue should be handled carefully with tissue forceps. This should be done gently to avoid crushing or mutilating the specimen.

(5) The crust or slough of a lesion will not show the characteristics of the tissues. It is therefore necessary to include typical neoplastic and normal surrounding tissues in the biopsy.

(6) When the electrocautery or high-frequency cutting knife is used, care should be taken not to destroy the the character of the cells by heating or dehydration.

(7) After the tissue has been removed, it should be immediately placed in a preservative solution. In most cases, a 10 per cent formalin solution is quite satisfactory.

Q. *How does cancer rank in importance as a cause of death?*

A. Cancer is second only to heart disease in mortality tables. Many of the diseases that once more frequently caused death than cancer, have had their mortality rate greatly decreased but cancer has consistently increased its toll. It is estimated that of an initial group of 100 white women, thirteen will eventually die from this malady Of a like number of white males, ten will untimately die from cancer. White women show lower death rates from the disease than colored women, but white men have a higher death rate from cancer than do colored men. The peak age of incidence for cancer falls in the prime of life; at age 41. It seems apparent that cancer is a malady respecting no age, sex nor creed, no social or economic class.

Q. *What is the responsibility of the dental profession in regard to cancer of the mouth?*

A. In the early recognition and the prevention of cancer of the mouth, the dental surgeon plays an important role. Dental hygiene is a prime factor Viewing as suspicious a persistent leukoplakia and confirming suspicions with a biopsy is a highly commendable attitude Procrastination in diagnosis and incomplete treatment

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may be fatal to the patient. Early diagnosis and careful treatment, if not always affording a cure, will, at any rate, in many instances, prolong the life of the patient.

There are numerous questions yet to be answered concerning cancer. It is a subject which is important to both the physician and the dentist and necessitates their working together. Recent advances in science, especially in the fields of bacteriology, pathology and roentgenology, have extended enormously the biologic importance of dentistry and have had an influence in the development of favorable relations between medicine and dentistry and their intimate mutual responsibility as servants of the public health.

It is, however, fundamentally important that each profession understand the problems of the other in order that the patient may receive the full measure of benefit offered by modern science. The reward of the practice of dentistry and medicine lies not only in service to others and in satisfaction derived from intellectual interchange of thought, but also in the realization that both professions are still but pioneers; and in the hope that by cooperation and concentrated effort the development of improved procedures and useful discoveries may be even more effective in relieving human suffering and extending useful lives without the dread of cancer.

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carcinoma of the cervix, bladder and prostate. Tumors of the alimentary tract may cause death by obstruction. Intracranial tumors cause death by pressure effects within the rigid casing of the nervous system.

Q. *What are the chief advances of experimental cancer research in the immediate past?*

A. (1) Certain tumors are transplantable from animal to animal within a given species.
(2) Malignant tumors can be initiated by the use of carcinogenic agents.
(3) Certain tumors such as the chicken sarcoma of Rous can be transferred by means of a cell free filtrate or extract and are apparently of viral etiology.

Q. *Give a histo-pathological classification of tumors.*

A I. Epithelial tumors
- A. Benign
  - (1) Papilloma
  - (2) Adenoma
  - (3) Ameloblastoma
- B. Malignant
  - (1) Squamous-cell carcinoma
  - (2) Basal-cell carcinoma
  - (3) Adenocarcinoma
    - (a) Mucoid carcinoma
    - (b) Scirrhous carcinoma
    - (c) Carcinoma simplex

II. Connective Tissue Tumors
- A. Benign
  - (1) Fibroma
  - (2) Lipoma
  - (3) Neurofibroma
  - (4) Myxoma
  - (5) Chondroma
  - (6) Osteoma
  - (7) Myoma
  - (8) Lymphoma
  - (9) Angioma
    - (a) Hemangioma
    - (b) Lymphangioma
- B. Malignant
  - (1) Fibrosarcoma
  - (2) Lipoma
  - (3) Neurogenic sarcoma

(4) Myxosarcoma
(5) Chondrosarcoma
(6) Osteogenic sarcoma
(7) Myosarcoma
(8) Lymphosarcoma
(9) Angiosarcoma
(10) Undifferentiated sarcoma
  (a) Spindle-cell sarcoma
  (b) Small round-cell sarcoma
  (c) Large round-cell sarcoma
(11) Mesothelioma

III. Mixed Tumors
  A. Benign form
  B. Malignant form

IV. Teratomas
  A. Benign form
  B. Malignant form

Q. *What is a fibroma?*

A. A mesenchymal tumor derived from and composed of fibrous connective tissue. It is of wide distribution.

Q. *What is a keloid?*

A. This is an excessive formation of a fibrous scar resulting in a tumor-like mass resembling a fibroma. Certain individuals, particularly among the Negro race, are prone to this excessive fibrosis following injuries to the skin.

Q. *What is a lipoma?*

A. This is a benign, circumscribed mass of adult type of fat tissue.

Q. *What is a myxoma?*

A. It is a modified form of fibroma in which a mucoid intercellular substance separates embryonic connective tissue cells so as to resemble in appearance the tissue of the umbilical cord.

Q. *What is a myoma?*

A. This is a benign tumor of muscle tissue.

Q. *What is an angioma?*

A. This is a tumor composed of endothelial cells tending to form blood or lymphatic channels.

Q. *What is a glioma?*

A. A tumor arising from neuroglia or supporting cells of the central nervous system.

Q. *What is a teratoma?*

A. A tumor containing organs or distinct fetal structures representing all three primitive layers of blastoderm. It is really an

attempt at development within one individual of another individual of the same species. It is derived from totipotential cells which are capable of differentiation into any organ or tissue, and which in the right circumstances and environment would develop into a complete individual.

Q. *What is the cause of cancer?*

A. The cause of cancer is unknown. Nevertheless, certain factors may be considered as contributing causes. There is a controversy relative to the importance of heredity. While many students of the disease believe that there is an hereditary tendency, just as many hold the opposite opinion. Cancer of the mouth occurs most frequently in males during the 4th and 5th decade. Some of the causes are thought to be irritation caused by smoking and chewing tobacco, heat and pressure from the stem of a pipe, rough and jagged teeth, ill-fitting dentures, restorations of dissimilar metals, poor mouth sanitation or long continued inflammations.

Q. *Differentiate between benign and malignant tumors.*

A.

	Benign	*Malignant*
1.	Grow slowly	Grow rapidly
2.	Expansive growth	Invasive growth
3.	Usually encapsulated	Not encapsulated
4.	Do not recur after careful removal	Recur after incomplete removal
5.	Do not metastasize	Do metastasize
6.	Do not kill unless they compress vital organs	Do kill
7.	Rarely show necrosis and ulceration	Often necrosis and ulceration
8.	No cachexia	Cachexia and anemia
9.	Consist of well differentiated cells	Consist of poorly differentiated anaplastic cells
10.	Cells are rather uniform in size and shape	Polymorphism of cells
11.	Nuclei take up stain normally	Hyperchromatic nuclei
12.	Few mitosis	Numerous multipolar mitoses
13.	Fairly good imitation of the arrangement of the tissue from which they are derived	Unsuccessful imitation of the tissue of origin
14	Cells do not infiltrate	Cells do infiltrate

Q. *How do tumors cause death?*

A. 1. By pressure upon vital organs.
2. By invading vital organs and causing degeneration.
3. By hemorrhage resulting from ulceration and degeneration.
4. By absorption of poisonous products formed by the destruction of tumor cells.
5. By exhaustion due to the tumor using up so much nutrition for its own benefit.

Q. *What is meant by precancerous lesions?*

A. The term is applied to those conditions which are known to become malignant. These are pathologic conditions which in themselves are not malignant but which may develop into malignancy.

Q. *What is Virchow's theory of tumor formation?*

A. Virchow's theory, the mechanical irritation theory, states that new growths arise in tissues that have been the seat of injury or chronic irritation. Certain cases seem to uphold this theory, such as epithelioma of the lower lip of pipe smokers and carcinoma of the gall bladder associated with gallstones.

Q. *What is Cohnheim's theory of tumor formation?*

A. This is the embryonic rest theory. He believed that in early stages of embryonic development more cells were produced than were required for the formation of the tissue involved so that there remained unused a number of cells which on account of their embryonic character were endowed with the power of marked proliferation. He thought that they could lie latent for many years and develop later in life if conditions should become favorable.

Q. *What is the relation of mortality of cancer between the poorer and more wealthy people?*

A. Cancer mortality is lowest where conditions of life are hardest, the surroundings the most squalid, where the tubercle mortality is highest, the general and infantile mortality greatest and where sanitation is least favorable, in short, among the poor of the industrial class of our great towns, whereas among the wealthy and well-to-do, where the standard of health is at its best and life is easiest and where conditions are the reverse of the foregoing, the mortality is the highest.

Q. *Can cancer be cured?*

A. Yes, many types of cancer can be cured if discovered early and treated promptly.

Q. *Is cancer contagious?*

A. No. There is no danger of catching cancer by coming in contact with a person who has such a lesion.

Q. *Is cancer inherited?*

A. No. But it may be that in some families there is lowered resistance on the part of certain tissues or organs to the factors which favor development of cancer.

Q. *Is cancer infectious?*

A. No.

Q. *Is cancer caused by a microorganism or parasite?*

A. No.

Q. *Is cancer wholly due to local injury?*

A. No.

Q. *Does cancer appertain to any particular occupation?*

A. No.

Q. *Does cancer affect all sexes, races and classes of people?*

A. Yes.

Q. *Is cancer confined to any location or section of the earth?*

A. No.

Q. *What is the first principle in the treatment of cancer?*

A. It is the recognition and knowledge of the difference in response of cancer to treatment in its early as compared to its late stages.

Q *How is the differential diagnosis made?*

A. Only by biopsy and microscopical tissue examination

Q. *What are the methods of obtaining tissue for microscopical examination?*

A. 1. Incisional· scalpel, cautery, or radio scalpel
2 Various punch methods
3. Curettage
4. Paracentesis for the examination of fluids for tumor cells
5. Aspiration

Q. *How is aspiration biopsy performed?*

A. It consists of withdrawing cells from a human through a large bore needle under strong suction.

Q. *What are the reactions to excess radiation in treatment of tumors?*

A. 1. Odd taste
2. Nausea and vomiting
3 Edema
4. Erythema
5. Radiation ulcers and necrosis
6. Epidermitis

Q. *What is a treatment of local reaction to excess radiation in treatment of cancer?*

A. 1. Application of calomine lotion or ointments containing anesthetics.
2. Tannic acid jelly for denuded areas.
3. In late radiation ulcers, hypertonic magnesium sulfate solutions are of value in combatting secondary infection and edema.

Q. *What do we mean when we speak of the quality of x-ray?*
A. We are referring to the wave lengths present.

Q. *What is hard radiation?*
A. Short wave length.

Q. *What is soft radiation?*
A. Long wave length.

Q. *What is a roentgen?*
A. It is a unit defined in 1928 by international agreement based on the absorption of x-ray energy in air. One roentgen produces in one cc of air roughly two billion ion pairs which will transfer an electrostatic unit of electricity.

Q. *What is the commonest of all visceral malignancies?*
A. Gastric carcinoma.

Q. *Who were the first men to produce malignant neoplasms on experimental animals?*
A. Yamagiwa and Itchikawa were the first to produce malignant tumors experimentally in 1915 by repeated application of coal tar on the ears of rabbits.

Q. *What is the aim of the surgical approach in the treatment of cancer?*
A. To remove by the most direct means every particle of the tumor and its assumed extensions.

Q. *How many deaths resulted from cancer in the U. S. in 1950?*
A. An estimated 210,000 persons.

Q. *Does cancer begin with a definite symptom or symptoms?*
A. More often the early symptoms of cancer are scarcely noticeable; there may be nothing more than a slight change from the normal.

Q. *What are the early warning signs of cancer?*
A. 1. A lump or thickening anywhere in the body, especially in the breast, lip, or tongue. Any change in the size, shape or position of the breasts.
2 Irregular or unexplained bleeding from the nipple, vagina, or any body opening; blood in the urine or stools.
3. A sore that does not heal, particularly about the tongue, mouth or lips.
4. Progressive change in the color or size of a mole, wart, or birthmark.

5. Persistent indigestion, especially in persons over 40 years of age.
6. Persistent change in normal bowel habits.
7. Persistent hoarseness, sore throat, or difficulty in swallowing.

Q. *Name some of the radioactive isotopes now being used in the treatment of cancer.*

A. (1) Iodine is being used with dramatic results in about one out of five thyroid cancers.
(2) Phosphorous is helpful in some cases of leukemia.
(3) Cobalt serves as a good substitute for radium.
(4) Nitrogen mustard has been effective against lymphatic forms of cancer, particularly some forms of leukemias and Hodgkin's disease.
(5) Hormones help male patients with cancer of the prostate and some women with breast cancer.
(6) The pituitary hormone, ACTH, and the adrenal cortical hormone, cortisone, show promise for leukemic children.

Q. *What per cent of skin cancer can be cured?*

A. 95 per cent when diagnosed early
40 per cent of late cancer

Q. *What per cent of lip cancer can be cured?*

A. 90 per cent of early cases
15 per cent of late cases

Q. *What per cent of breast cancer can be cured?*

A. 90 per cent of early cases
Less than 25 per cent of late cases

Q. *Do chemicals cause cancer?*

A. Scientists have found that some 400 chemicals will cause cancer.

Q. *Does over exposure to the sun and weather cause skin cancer?*

A. Skin cancer among fishermen, sailors and farmers is quite prevalent, thus over exposure is believed to be a factor in causing skin cancer.

Q. *Is it possible to immunize a person against cancer?*

A. Possibly. Some animals can be immunized against some types of cancer.

Q. *What type of cancer is increasing more rapidly than any other?*

A. Lung.

Q. *Classify diagnostic cancer tests.*

A. (1) Tests based on chemical changes
(a) In urine
(b) In blood
(c) In body secretions
(2) Tests based on immunological principles
(a) In urine
(b) In blood and tissues
(3) Tests based on enzymological principals
(a) In urine
(b) In blood

Q. *In what group of women is cervical cancer most prevalent?*

A. Cervical cancer is a disease of childbearing women and is usually preceded by cervical lacerations and irritating cervical catarrh.

Q. *What constitutes a diagnosis of cancer and by what means can it be accomplished?*

A. A diagnosis may be said to have been obtained when the clinician has been placed in command of data which will enable him to understand the origin, course and prognosis of the case in hand. This information must include the results of the physical examination of the patient, roentgenographic study, and histological study, which reveal the structure of the tumor, the origin of the tumor, its grade of malignancy, and the grade of radiosensitivity.

Q. *What prophylactic care of the skin should outdoor workers take to prevent precancerous lesions?*

A. Frequent cleansing of the skin, with mild, nonirritating soap, using copious quantities of water and followed by the application of U S. P. cold cream three or four times daily. The precaution of protecting the skin of a patient, who is predisposed to the development of these lesions, by wearing a hat which will shade the face or gloves to protect the hands, is obvious.

Q. *What are the advantages of completely removing a suspected cancer lesion at the time of biopsy?*

A. The surgeon is rendered a diagnosis of the tissue removed and whether the margins and depths of the remaining defect are completely free of further tumor invasions. The surgeon may then cleanse the wound with minimal disturbance to the patient and obtain a satisfactory result through healing which shows minimal scar and distortion. The patient's period of incapacity will be reduced to the smallest possible time.

Q. *When should the surgeon repair the defect resulting from excision of a lesion?*

A. Theoretically one should wait for a period of two to five years but usually patients are unwilling to wait. Most surgeons make repairs within a period of 6 months to 1 year.

Q. *What are the most common sites of cancer in the mouth?*

A. Lips.
Mucosa lining the buccal cavity and covering the alveolar ridge.
Tongue.

Q. *What is the appearance of basal cell carcinoma of the skin?*

A. Basal cell carcinoma of the skin appears as a small nodule, and grows slowly. It ulcerates, becoming slightly raised, and forms a crust with a pearly appearance around its borders. Most authorities agree that it does not metastasize, but it invades and destroys the surrounding tissues.

Q. *What is the appearance of squamous cell carcinoma and how does it begin?*

A Characteristically, this growth begins as a warty area, or in a region of chronic scaling of the skin. It develops rapidly into an ulcer with indurated borders. The base bleeds freely when the crust is removed and infection commonly occurs. It metastasizes readily. Regional lymph nodes should always be examined carefully.

Q. *What is the most common type of cancer in women?*

A. Cancer of the breast.

Q. *Do moles become cancerous?*

A. All do not, but they may undergo a malignant transformation, and develop into one of the deadliest and most rapidly fatal forms of cancer known—the malignant melanoma.

Q. *What type moles comprise the dangerous group?*

A. The junction nevi, arising from the epidermal junction in the skin. These moles are small, relatively smooth, hairless growths, often present since birth They are flat, or only slightly raised, and range in color from light brown to black The junction nevus occurs most frequently on the hands, feet and genitals.

Q. *Should moles be biopsied?*

A. Benign moles and those suspected of being malignant should not be subjected to any form of biopsy but should be removed by delicate and often liberal surgical resection, followed, if proven malignant, by radiation.

Q. *What is leukoplakia?*

A. Leukoplakia is the most definite precancerous lesion of the tongue. It is a hyperkeratosis of the mucous membrane epithelium which usually appears as a sharply demarcated, slightly opaque, white patch. In early stages it is flat and not palpable, but without

treatment it tends to become raised, finely granular, or even papillary in texture and definitely palpable. Opacity usually increases with age, some lesions becoming cream-colored, gray, or yellow-tinged. Induration of this keratinized area may occur, and with it fissures may develop. Ulceration or flaking is not uncommon in more severe cases. Leukoplakia is significant as a precancerous lesion mainly because it indicates the existence of chronic irritation.

Q. *Why is squamous cell carcinoma of the lip of particular importance to the dentist?*

A. Squamous cell carcinoma of the lip occurs very frequently and an accurate clinical diagnosis is so essential in a condition with such a serious prognosis.

Q. *What is the treatment of choice among clinicians for squamous cell carcinoma of the lip?*

A. Surgical operation is the treatment of choice; second, is surgery and irradiation; and third, is irradiation.

Q. *How does metastasis occur in cases of squamous cell carcinoma of the lip?*

A. By way of the lymphatic vessels, the cervical and sub-mental nodes usually being the first affected.

Q. *What is the pathology of cancer of the floor of the mouth?*

A. In nearly all cases, a cancer of the floor of the mouth is a squamous-cell epithelioma. Sometimes, a transitional-cell epithelioma is found and, in rare instances, an adenocarcinoma developing from the salivary tissue may occur.

The lesion originates in the mucosa of the floor of the mouth, commonly around the orifice of the submaxillary duct on either side of the frenum, and rapidly extends to the undersurface of the tongue, to the gingival and buccal mucosa, and in some cases, to the lips. It is a slow-growing, but a rapidly invasive lesion, readily piercing the adjacent musculature of the floor of the mouth, and, at times even invading the jawbone. Its spread through the lymphatics is early, involving the sub-maxillary nodes, the superior and deep cervical nodes, and when the lesion is in the anterior portion of the floor of the mouth, the inferior deep cervical and the submental lymph nodes.

Q. *What is the prognosis of cancer of the floor of the mouth?*

A. The prognosis in cancer of the floor of the mouth is always grave. Moreover, in most instances, treatment is requested after the lesion is far advanced. As in carcinoma elsewhere, best results are achieved when the lesion is recognized early and radically treated at once.

Q. *List the precancerous lesions of the tongue.*

A. (A) Leukoplakia
(B) Syphilis
(C) Ulceration
(D) Lichen planus
(E) Fissures
(F) Warts, or any sore of the tongue

Q. *Does carcinoma of the lip occur more frequently in men or women?*

A There is an average of 93 3 per cent in men and 6.7 per cent in women, roughly a ratio of 14 to 1.

Q. *What is the treatment for a tumor of the salivary glands?*

A. The treatment is block dissection of the cervical nodes, especially of the posterior chain, and complete removal of the gland and such adjacent bony structures as may be involved Radiation therapy should not be attempted. The prognosis is poor

Q. *Does radiation therapy affect tooth structure?*

A In addition to the undesirable effects and frequent serious sequelae of cancer–lethal radiation on the alveolar process, radiation therapy may produce specific injury to the teeth themselves Often after an interval of months or even a week or two following radiation therapy, a chalky debilitation of the teeth in the field of radiation develops so that they chip and crumble always leaving irregular edges of knife-like sharpness. There is no known remedy for such diseased teeth, but it is best to grind down the sharp edges and avoid wholesale extraction A second dental complication following radiation therapy for mouth cancer is persistent toothache in the teeth situated within the direct beam of radiation When these teeth are extracted, osteomyelitis usually results. These complications are the principal reasons why cancer of the gum is preferably treated by surgery

Q *From what do secondary malignancies within the bone result?*

A. (1) Direct extension from contiguous primary cancer
(2) Direct extension from adjacent metastatic cancer in a lymph node
(3) Invasion along the inferior dental canal by way of the mental foramen
(4) Blood borne metastasis from the breast or thyroid or some other primary site

Q *List the rules that should be kept in mind when taking a biopsy.*

A. (1) A representative lesion should be chosen from which the biopsy specimen is to be obtained. It is important not to

paint the area with any colored antiseptic which might interfere with the later staining of the tissue for microscopic examination.

(2) Thin deep tissue sections should be removed rather than broad shallow pieces since a broad shallow section of tissue might not show the evidence of invasion of the underlying tissues with the malignant cells.

(3) Since normal as well as abnormal tissues should be available for the pathologist, a specimen should be taken through the margin of the lesion.

(4) The excised tissue should be handled carefully with tissue forceps. This should be done gently to avoid crushing or mutilating the specimen.

(5) The crust or slough of a lesion will not show the characteristics of the tissues. It is therefore necessary to include typical neoplastic and normal surrounding tissues in the biopsy.

(6) When the electrocautery or high-frequency cutting knife is used, care should be taken not to destroy the the character of the cells by heating or dehydration.

(7) After the tissue has been removed, it should be immediately placed in a preservative solution. In most cases, a 10 per cent formalin solution is quite satisfactory.

Q. *How does cancer rank in importance as a cause of death?*

A. Cancer is second only to heart disease in mortality tables. Many of the diseases that once more frequently caused death than cancer, have had their mortality rate greatly decreased but cancer has consistently increased its toll. It is estimated that of an initial group of 100 white women, thirteen will eventually die from this malady. Of a like number of white males, ten will untimately die from cancer. White women show lower death rates from the disease than colored women, but white men have a higher death rate from cancer than do colored men. The peak age of incidence for cancer falls in the prime of life; at age 41. It seems apparent that cancer is a malady respecting no age, sex nor creed, no social or economic class.

Q. *What is the responsibility of the dental profession in regard to cancer of the mouth?*

A In the early recognition and the prevention of cancer of the mouth, the dental surgeon plays an important role. Dental hygiene is a prime factor. Viewing as suspicious a persistent leukoplakia and confirming suspicions with a biopsy is a highly commendable attitude. Procrastination in diagnosis and incomplete treatment

may be fatal to the patient. Early diagnosis and careful treatment, if not always affording a cure, will, at any rate, in many instances, prolong the life of the patient.

There are numerous questions yet to be answered concerning cancer. It is a subject which is important to both the physician and the dentist and necessitates their working together. Recent advances in science, especially in the fields of bacteriology, pathology and roentgenology, have extended enormously the biologic importance of dentistry and have had an influence in the development of favorable relations between medicine and dentistry and their intimate mutual responsibility as servants of the public health.

It is, however, fundamentally important that each profession understand the problems of the other in order that the patient may receive the full measure of benefit offered by modern science. The reward of the practice of dentistry and medicine lies not only in service to others and in satisfaction derived from intellectual interchange of thought, but also in the realization that both professions are still but pioneers, and in the hope that by cooperation and concentrated effort the development of improved procedures and useful discoveries may be even more effective in relieving human suffering and extending useful lives without the dread of cancer.

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Glossary

Abrikossoff's tumor. — A tumor of striated muscle made up of groups of cells which resemble primitive myeloblasts, usually following muscle injury. Etiology of this tumor is still a matter of speculation. It occurs mainly in the tongue.

Acanthotic nevus. — *This condition may be described as a pigmented senile* wart, but has been called keratosis seborrheica, epithelial papilloma, epidermoid nevus, and benign melanotic epithelioma. The clinical picture is that of a brown to blackish tumor which is sharply demarcated and appears as though pasted onto the skin. When a malignant growth develops in one of these, a rare event, the growth is a squamous-cell carcinoma.

Treatment. — Surgery in some cases, but in most instances treatment is not necessary.

Prognosis. — Generally favorable.

Acinous carcinoma. — A malignant tumor of the epithelial group having an acinous structure, and including the encephaloid and scirrhus.

Acoustic nerve tumor. — A tumor growing from the sheath of the acoustic nerve at the cerebropontine angle. The clinical course is of a slowly growing tumor, but inaccessibility, adhesions, and destruction of neighboring vital tissues yield an unfavorable prognosis.

Acute carcinoma. — An encephaloid, or soft cancer. It shows a diffuse edema of the overlying skin much larger than the localized tumor. It is frequently found on the breast and is treated by radical surgical mastectomy.

Acute splenic tumor. — A swelling resulting from acute splenitis.

Adamantinoma. — An epithelial tumor of the jaw originating from the epithelial rests of Malassez or from other epithelial remnants of the developmental period of the enamel. Development of this tumor is slow. *The superficial growths may be readily extirpated, but deep cysts may* require sacrifice of the maxilla.

Treatment. — Radical surgical removal of bone containing entire tumor.

Prognosis. — Unfavorable.

Adamantoblastoma. — *A tumor formed from epithelium with the ability to* differentiate into enamel epithelium without actually forming enamel (same as adamantinoma).

Treatment. — Surgery.

Prognosis. — *Varies with malignancy (considered locally malignant).*

Adenoadamantoblastoma. — A tumor formed from oral epithelium with a tendency to glandular structure formation as well as dental structures.

Adenoameloblastoma. — A tumor composed of enamel and glandular epithelium.

Treatment. — Surgery followed by cauterization.

Prognosis. — Varies with malignancy.

Adenocarcinoma. — A carcinoma in which the malignant cells are arranged in the form of glands. *It is the malignant counterpart of adenoma.* It has a slow development and its natural history is prolonged. Superficial growths may be easily extirpated. This tumor is rarely found in the oral cavity and is non-encapsulated and highly invasive.

Treatment. — *By radical excision, irradiation, and implantation of radium.*

Prognosis. — Unfavorable.

Adenolymphoma. — A variety of salivary gland tumor occurring principally in or about the parotid gland.
Treatment. — By surgical excision.
Prognosis. — Good
Adenoma. — A benign tumor derived from glandular or secretory cells. It has usually a slow rate of growth, a well-defined margin, and quite accurately reproduces the tissues from which it is derived. The tumor cells may function and produce a secretion similar to, or the same as produced by, the normal glandular tissue. It has limited growth capacity.
Treatment. — Surgery.
Prognosis — Varies with the organ affected
Adenomyosarcoma.— A tumor composed of glandular and mucous tissue. It is malignant and belongs to the sarcoma group.
Adenosarcoma. — The malignant form of adenofibroma which is encapsulated in the early stages.
Treatment. — Surgery.
Prognosis. — Unfavorable.
Adipose tumor. — A tumor made up of fat cells, arranged in lobules with a variable amount of supporting connective tissue and blood vessels. It metastasizes or invades to various surrounding organs
Alveolar carcinoma. — The same as colloid carcinoma The jaw may be affected by invasion of the growth, and the lower third molar region is a common site for its appearance. If treated by irradiation, the jaw may be involved by osteomyelitis, and pathological fracture is not uncommon.
Ameloblastoma. — Any tumor which originates from and contains ameloblastic cells of enamel follicles of unerupted or otherwise embedded teeth (same as adamantinoma).
Treatment and prognosis — Same as for adamantinoma
Amyloid tumor. — A tumor containing a starch-like protein form between the cells. The intestine is an important site of massive amyloid deposit.
Angioma. — A tumor composed of endothelial cells tending to form blood or lymphatic channels consisting of both benign and malignant forms.
Treatment — By radium, carbon dioxide snow, or electrothermic methods
Prognosis — Will vary with location.
Angiosarcoma. — A sarcoma containing very many fine blood vessels
Aniline tumor. — A cancer appearing in workers in the synthetic aniline dye industry The aniline dye is most commonly blamed for causing bladder carcinoma, but incorrectly so, according to some authorities
Appliance. — A devised instrument which may be applied to effect a result.
Arsenical cancer. — A cancer which results from the prolonged use of arsenic for various skin diseases.
Astrocytoma. — A tumor composed of astrocytes, a typical adult glioma
Treatment — Surgery.
Prognosis — Comparatively favorable
Basal cell. — One of the cells of the deep layer of the epithelium.
Basal cell carcinoma. — A malignant lesion which occurs more commonly upon the skin and lips It may occur on the oral mucosa. When such tumors occur on the lips, they are more common on the upper lips than the lower The early lesion is usually a chronic ulcer which refuses to heal and from which the basal cell carcinoma progresses slowly. It is composed of basophilic staining cells of oval or polyhedral shape There is no tendency to differentiation or pearl formation Usually mitotic figures are infrequent It is sometimes termed a rodent ulcer
Treatment — Actual cautery is good, however, these are not completely resistant to radiation

Basal cell epithelioma.—A neoplasm derived from basal-cell layer of the epidermis or from similar cells of the cutaneous appendages.

Benign.—Not likely to recur, not malignant, innocent.

Benign melanotic epithelioma.—This condition is best described as a pigmented senile wart, but has been called keratosis, seborrheica, epithelial papilloma, and acanthotic or epidermoid nevus. The clinical picture is that of a brown or blackish tumor which is sharply demarcated and appears as though pasted onto the skin, occasionally pedunculated.
Treatment.—Surgical excision, actual cautery or electrosurgery.
Prognosis.—Good.

Benign tumors.—Those tumors which grow slowly and expansively, and are usually confined to a local area by capsule.

Benign giant cell tumor.—Growths characterized by the presence of giant cells.
Treatment.—Surgical removal
Prognosis.—Varies due to possibility of local recurrence

Biopsy.—An examination of tissue, normal or morbid, excised from the living body.

Blood tumor.—A hematoma; an aneurysm may also sometimes be known as a blood tumor.

Blue nevus.—A macular or papular lesion, usually less than one centimeter in diameter, of a distinct bluish or grayish hue, so colored because of the presence of dermal melanoblasts It is more common in the Mongolian races
Treatment.—Surgical excision of all nevi exposed to chronic irritation or trauma

Bowen's cancer.—A precancerous dermatosis marked by the formation of a pinkish papule or tubercle covered by a thickened horny layer The lesions may progress slowly for many years before becoming malignant.
Treatment.—Very resistant to treatment and is much like the basal cell carcinoma.

Brenner tumor.—A tumor of the ovary whose structure consists of groups of epithelial cells lying in a fibrous connecting tissue stroma When small the tumor may be solid, resembling a fibroma, when large it may appear like a cyst-adenoma with nodular masses of the tumor in the cyst's wall.
Treatment.—Conservative removal of just one ovary, radiotherapy is not indicated
Prognosis—Excellent after surgical removal

Brooke's tumor.—An epithelioma adenoides cysticum, according to Brooke When these tumors predominate on the scalp, they are turban tumors

Brown-Pearce tumor.—A malignant carcinoma of the skin having very little stroma and an irregular cell arrangement It metastasizes early.

Butyroid tumor.—A collection of material in the mammary gland closely resembling butter

Cancer.—The lay term for carcinoma, a malignant tumor composed chiefly of epithelial cells

Carcinogenic.—Agents which are capable of eliciting a neoplasm

Carcinolysis.—The destruction of cancer cells

Carcinoma.—A tumor derived from epithelial cells with connective tissue stroma which infiltrates readily and metastasizes
Treatment.—Surgery, roentgen rays, or radium implantation

Carcinoma adenomatosum.—A cancer with a disposition to form gland-like acini

Carcinoma cutaneum.—An epithelioma.

Carcinoma durum.—A scirrhous carcinoma

Carcinoma epitheliale adenoides.—A carcinoma forming in epithelial surfaces, but made up of adenoid or gland-like forms.

Carcinoma exulcere. — Carcinoma of the stomach developed from a simple ulcer.
Carcinoma fibrosum. — A scirrhous carcinoma.
Carcinoma gigantocellulare. — A carcinoma containing many giant cells
Carcinoma mastitoides. — A rapidly growing variety of breast cancer which, by setting up violent irritation, produces a round-cell infiltration resembling mastitis.
Carcinoma medullare. — A medullary cancer. The term is sometimes applied to the soft cellular tumors from a fancied resemblance to brain tissue. It is usually rapidly fatal
Carcinoma molle. — A medullary cancer.
Carcinoma myxomatodes. — A colloid cancer in which the stroma has undergone myxomatous degeneration.
Carcinoma nigrum. — A melanotic carcinoma.
Carcinoma ossificans. — A carcinoma in which there is a deposit of bone.
Carcinoma sarcomatodes. — A carcinoma showing transformation toward sarcoma.
Carcinoma scroti. — A cancer of the scrotum.
Carcinoma simplex. — Carcinoma in which the relative proportion between the stroma and the cells is normal.
Carcinoma telangiectaticum. — A cancer involving the cutaneous capillaries and producing telangiectatic changes.
Carcinoma villosum. — A malignant papilloma.
Carcinophilia.— A special affinity for cancerous tissue
Carcinophobia. — A fear or dread of cancer.
Cartilaginous tumor. — A chondroma or an enchondroma
Cellular tumor. — A tumor composed chiefly of cells in a homogeneous stroma
Cementoma. — Outgrowths of cemental tissues, or hypercementoses They are essentially osteomas having a dental origin and are surrounded by pericemental tissues.
Treatment. — Surgical removal
Prognosis — Good.
Central adenoma. — A rare tumor derived from the epithelium which develops intraosseously.
Treatment — By enucleation followed by cauterization
Central epidermoid carcinoma. — A rare type of carcinoma which develops from the cell rests of the sheath of Hertwig
Treatment. — Radical surgery.
Central fibroma. — A rare tumor formed from the mesenchymal part of the tooth germ
Treatment — Conservative excision
Prognosis. — Good.
Central giant cell tumor. — A solitary lesion in the otherwise normal skeleton, is not separated from normal tissue by a capsule, and infiltrates the adjoining tissue by extension through the marrow spaces.
Treatment. — Thorough curettage followed by cauterization
Chondroma. — A benign tumor composed of cartilage It arises from the perichondrium or from the periosteum of the bone.
Treatment — Early surgical removal or prolonged radiation.
Prognosis — Favorable
Chondrosarcoma. — A cartilaginous sarcoma characterized by rapidity of growth It occurs most frequently near the ends of long bones. It is a malignant tumor
Treatment — Radical surgical extirpation
Prognosis — Chondrosarcomas arising peripherally from exostoses have a relatively good prognosis

Chordoma. — A rare tumor which arises from notochordal remnants at the upper or lower ends of the vertebral column. It is composed of large, clear, closely packed cells having a vacuolated cytoplasm
Treatment — Surgery
Prognosis — Unfavorable, but the patient may survive for some time due to the slow growth of the lesion

Chorionic carcinoma. — A carcinoma of the chorion The chorionic carcinoma is usually small, hemorrhagic, and soft.
Prognosis — Unfavorable, as metastasis is invariably present when the lesion is discovered

Chromaffin tumor. — A paraganglioma It is benign, grows slowly, and has little tendency to metastasize

Chromatophore. — The name applied to the special colored cells which typically send out numerous protoplasmic extensions

Chronic carcinoma. — Scirrhous or hard cancer

Chronic leukemia. — A classification of various generalized malignant diseases of the leukocyte producing tissues with a relatively slower growth potentiality and greater cell differentiation

Cock's peculiar tumor. — A septic ulceration of a neglected sebaceous cyst of the scalp, simulating an epithelioma

Coley's mixed toxins. — Unfiltered mixtures of erysipelas and prodigiosus cultures They are injected for the treatment of inoperable tumors

Colloid carcinoma. — A carcinoma in which the cells have undergone colloid degeneration
Treatment. — Surgical removal
Prognosis — Unfavorable

Colloid tumor. — A myxoma

Comedo carcinoma. — A carcinoma of the mammary duct from the cut surface of which wormlike casts can be expressed
Treatment — Surgery, a radical mastectomy
Prognosis — Variable

Compound odontoma. — One which contains a large number of miniature, well-formed, and misshapen teeth Usually they are contained within a cystic sac, and it may or may not contain a portion of a well-formed tooth within its boundaries

Connective tissue tumor. — Any tumor that develops from some structure of the connective tissue

Cylindrical carcinoma. — A carcinoma in which the cells are cylindrical or nearly so

Cylindroma — An epithelioma composed of translucent cylinders of hyaline connective tissue with a network of tumor cells interspersed They make up 10 to 20 per cent of the salivary gland tumors of the parotid and submaxillary gland.
Treatment — Surgical excision
Prognosis — Varies

Cyst. — An unnatural cavity containing fluid and surrounded by a definite and complete wall

Cystadenoma. — An adenoma which is associated with cystoma
Treatment — Surgery
Prognosis — Varies

Cystadenoma adamantinum. — An epithelial tumor of the jaw originating from the epithelial rests of Malassez or from other epithelial remnants of the developmental period of the enamel

Dental cyst. — Also known as radicular cyst. This is a cyst attached to the root of a tooth. Usually it enlarges and thereby makes the jaw larger. Also, it involves adjacent teeth, however, sometimes the adjacent teeth are not affected seriously. A dental cyst will usually displace adjacent teeth considerably even if great damage is not done.

Treatment.— The involved tooth is removed and if the cyst sac is not too large, it will come out with the tooth, otherwise, the cyst may be removed by use of a window incision usually on the buccal or labial surface of the jaw. Antibiotics should be used preoperatively and postoperatively and a drain inserted after the cyst is removed.

Dentigerous cyst. — Whereas a radicular cyst forms around the apices of teeth, the dentigerous cyst forms around the crowns of unerupted teeth It is therefore most often found in young people. Dentigerous cysts are divided into central and lateral types. The central occurs over the occlusal surfaces of unerupted teeth whereas the lateral type occurs along the buccal, labial, lingual, mesial or distal surfaces of a tooth. The central type may cause depression of the tooth into the socket. The lateral type causes displacement of the involved tooth, if the cyst is large enough, and also displacement of adjacent teeth.

Treatment. — Surgical removal No part of the epithelial membrane should be left as it will have adamantoblastomatous potentialities. In case of a large maxillary dentigerous cyst, the bony wall may be removed under the inferior turbinate and the area allowed to drain through the nose, after the cyst is removed.

Dentinoma. — A tumor made up of calcified dentin Under the microscope, numerous canals containing nerve and pulp tissue can be seen, resembling root canals of regular teeth. Many times it is seen over the occlusal surfaces of teeth and contains a surrounding capsule

Dermoid. — An incompletely formed teratoma containing one or more germinal layers The usual case is disorderly arrangement However, cases have been reported where a tooth or teeth develop in the ovaries, testes and external auditory canal.

When dermoid cysts are found in the sex glands, they usually contain hair, nails, and teeth or any combination of the three They can be removed surgically.

Dermatology. — The study of skin disorders

Desmoid. — A tumor usually seen in the anterior abdominal wall and arising from muscular aponeurotic structures It is usually associated with the long labor at childbirth and trauma in an operative scar It may be palpated and moved beneath the skin and contain a capsule

Treatment. — A large excision to be certain of total removal.

Prognosis — Good if the complete tumor is removed If not, it may recur

Dopa reaction. — Melanin is the chief pigment of the skin It is seen as fine granules in and between the cells of the stratum germinativum. It is produced from 3, 4- dihydroxyphenylalanine by an enzyme, called the "dopa" enzyme This is known as "dopa reaction".

Melanomas are tumors arising from cells that are capable of producing pigment or melanoblasts The melanoblast is thought to be a modified basal cell of the epidermis and capable of producing a pigmented material from 3, 4-dihydroxyphenylalanine by means of its oxidizing ferment Therefore, this reaction is an aid in distinguishing melanomas

Embryonal carcinoma. — Also known as seminoma carcinoma. This is a tumor that has its origin in the epithelium of the seminal tubules Their incidence is 60 to 70 per cent A more widely accepted concept is that they are an overgrowth of one type of cell, namely a monodermal development of a tumor usually tridermal in origin. They are homogeneous, not cystic, pinkish-yellow, and only rarely is an area of hemorrhage and necrosis seen These tumors may increase the size of the testes or be present in an average size testis

Treatment — Orchiectomy and roentgentherapy postoperatively to areas of probable metastasis

Prognosis — Is better in seminomas than the other tumors of the testes.

Enameloma. — This condition is due to interference with the enamel organ while the tooth is being formed An excess of enamel may be seen on an otherwise normal tooth or small deposits of enamel may be laid down In case the interference takes place before the enamel has started to calcify, epithelial tumors containing enamel-forming cells may be seen. If the surrounding tissue is stimulated to proliferation, an ameloblastoma may be formed.

Endothelioma. — Here the endothelial cells form the tumor, but do not develop lymph and blood vessels The cell is of mesenchymal origin This cell is capable of changing its morphologic characteristics, producing intercellular substances as are formed by connective tissue cells and has the power to differentiate, which causes a difficulty in determining the specific type of tumor

It occurs very rarely in the floor of the mouth. The usual place of occurrence is on the hard or soft palate

It can occur at any age and has a slow rate of growth It is usually first detected when it interferes with mastication and speech The regional lymph nodes are usually not affected.

Ependymoma. — A type of glioma that comprises about 6 per cent of the gliomas It appears in the fourth ventricle commonly, along the central canal, and in the filum terminale and is derived from ventricular lining cells It is slow growing, but may cause acute increase of the intracranial pressure due to interference with the cerebrospinal fluid flow

Epidermoid carcinoma. — A carcinoma in which the cells resemble the epidermis. There are three main grades of epidermoid carcinoma Grade I has few or no mitotic figures, many epithelial pearls and the cells are uniform Grade II shows variation in the uniformity of the cells, a few epithelial pearls and mitotic figures, and a slight tendency to keratinization. Grade III has no keratinization, many mitotic figures and the cells are very disorderly arranged.

Epithelial papilloma. — A pigmented senile wart. Same as keratosis seborrheica

Treatment — Excision by surgery, electrosurgery or actual cautery In some cases treatment is not necessary.

Prognosis. — Good

Epithelioma. — The epithelial cells which make up this tumor are in formations like acini or large alveoli They vary in size and outline Between and in these cells will be found mucoid-hyaline material derived jointly from the epithelial cells by secretion and hyaline degeneration of the stroma Cells that have become broken off may be enclosed by the material The cells are mostly columnar or cuboidal in shape and have an abundance of cytoplasm

Epulis. — A localized hyperplasia of the gingiva or oral mucosa. The most common cause is mechanical irritation such as the sharp edges of a badly decayed tooth, an overhanging margin, subgingival calculus, and poorly fitting dentures Granulation tissue extruding from a socket or wound may be due to a spicule of bone or piece of a tooth in the socket Many of these cases recur after removal of the growth due to lack of removal of the etiological factors

Treatment — Remove the source of irritation along with the tumor

Ewing's tumor. — This tumor is called round cell sarcoma in the older literature. It is also known as endothelial myeloma It is believed to arise from the endothelial lining of blood vessels or lymphatics There are probably several histologic types It occurs early in life (four to twenty-five years of age) and rarely later. In the maxilla, the sinus is most often involved and the horizontal ramus in the lower jaw.

This tumor is soft and cellular, and often very vascular. It is divided into lobules by coarse connective tissue It infiltrates tissue surrounding the bone, but usually remains well outlined by a pseudo-capsule.

Treatment. — X-ray radiation, as these tumors are usually very radiosensitive.

Prognosis — Poor. Even with irradiation before and after excision, a permanent cure may not be obtained.

Fibroma. — This is a frequently occurring tumor of the oral cavity. It often arises from the oral mucosa, periosteum or periodontal membrane. It is well-defined, may be sessile or pedunculated and be of a firm or soft consistency.

It usually is slow in growing and has no associated pain. It interferes with speech and mastication. If subject to irritation, it may enlarge and become a fibrosarcoma.

Treatment — Surgical excision. The periosteum and cortex of bone in the area should be removed in sessile tumors

Prognosis. — Excellent, and it seldom recurs after complete excision.

Fibrosarcoma. — A malignant tumor that differentiates in the direction of fibrous connective tissue It is a rounded, lobulated tumor that is circumscribed or encapsulated. It can be hard and firm or soft and friable, depending upon the amount of fibrous tissue.

In the mouth, a fibrosarcoma arises from the alveolar periosteum or periodontal membrane. The subcutaneous fibrosarcoma arising from the jaws occurs most often in children and young adults. This type occurs at the chin and especially at the angle of the jaw. Fibrosarcoma of the maxillary sinus will eventually push through its bony enclosure, and involve the nose and face

Treatment — Radical resection

Prognosis — Poor, especially in advanced cases

Fluid tumor. — Same as a lymphangioma.

Treatment — Excision

Fulguration. — The destruction of tissue by means of high frequency cautery.

Gamma ray. — An electromagnetic wave emitted from a radioactive substance that has a great penetrating power

Gelatinous tumor. — This is also called a myxoma It is composed of a gelatinous, oozing mass. The tumor shows degeneration instead of specialization. It is seen mostly in young individuals and as it gives no symptoms, a deformity has usually occurred by the time it is detected. It is believed to be of odontogenic origin

Treatment — Radical excision but not resection

Giant cell epulis. — This is thought to be a vascular resorptive tissue in conjunction with the elimination of the remains of extravasations It is located more often on the labial or buccal than on the lingual surface. The bone is usually not involved. It has a medium rate of growth, and if bone is resorbed, it is by encroachment It can recur if all is not removed, but usually does not metastasize

Treatment — Radical surgical excision including the bone and adjacent teeth

Prognosis. — Good.

Glandular carcinoma. — An adenocarcinoma

Glioblastoma multiforme. — It is the second most common form of gliomas. It is very malignant, expands with great rapidity and is highly invasive. It is hemorrhagic and it is difficult to determine the line of demarcation from cerebral tissue.

Glomus tumor. — This is also known as an angiomyoneuroma. The tumor is formed of tangled blood vessels within a capsule. It usually occurs in the extremities. Also, it is extremely tender and painful. The glomus is formed by an arteriovenous anastomosis.

Granulation tumor. — This tumor is most often due to infection spreading from the infected pulp to the periodontal membrane. At the apex, there is a tendency to wall off the infection and for bacteria to enter the area The granulation tissue is formed at the expense of the bone. A fibrous capsule is formed by proliferating fibroblasts derived from the periodontal membrane The granuloma may stay small for several years but sometimes it involves a large area of the jaw It may develop into a radicular cyst It rarely becomes the forerunner of epidermoid carcinoma.

Treatment.— Must include removal of the infected tissues so that the granulation tissue may be filled in by normal bone. Root canal medication such as Lugol's solution sometimes gives good results However, a root canal followed by an apicoectomy is highly indicated in anterior teeth especially

Prognosis. — Good in granulomas

Growitz's tumors of the kidney. — This condition is a common malignant tumor of adults and is called hypernephroma. It is composed of "rests" of adrenal cells located in the kidney, usually just under the capsule At first the "rests" are separated from the kidney substance and well encapsulated Later on, the "rests" become invasive Degeneration, necrosis, hemorrhage and cyst formation take place, causing fibrosis and atrophy of the surrounding kidney structures Later on, there is invasion of renal tissue on a large scale The tumor cells metastasize along blood vessels and secondary tumors occur in the lungs and bones

Gummy tumor. — A condition identical to the gumma. The solitary gumma is most frequently found on the tongue, palatal mucosa and uvula. A sub-epithelial swelling sets in and later central necrosis and ulceration If the gumma is adjacent to bone, a perforation will usually result

Treatment. — Consists of penicillin, or aureomycin The older treatment was by using arsenic, mercury or bismuth with continuous treatment for twelve to eighteen months, without poisoning the patient

Hair-matrix carcinoma — Same as basal cell carcinoma

Treatment — Can take either of two forms One is by roentgentherapy but this may give facial paralysis The most satisfactory treatment is by radical surgery

Prognosis — Good

Hodgkin's disease. — A disease of unknown origin involving the lymph nodes, characterized by their painless progressive enlargement, progressive anemia, enlargement of the spleen, periodic fever, itching and weight loss. It occurs most frequently in young adult males and terminates fatally. It is synonymous with lymphogranulomatosis

Treatment — The present treatment is by radiotherapy Small daily doses (100 to 150 r) are most desired and should be protracted over several weeks This conserves the patient's general condition better and also cuts down on general reactions and skin and mucous membrane involvements The treatments should be localized, total body irradiation being reserved for advanced cases

In the acute stage, pregnancy should be interrupted. If not in the acute stage, it may be continued Irradiation to the pelvic area and abdominal cavity should be avoided the last six months due to the danger to the embryo.

Periods of remission may occur after the irradiations This is not unusual. Supportive treatment should accompany the radiotherapy Foci of infection should be removed, the diet should be balanced and transfusions may be of help.

A recent treatment is by using nitrogen mustards These have unpleasant side effects The small number of cases treated thus far offer no definite advantage yet to the effectiveness of this course of treatment

Prognosis — The prognosis of this disease is, over-all, poor. The longest case encountered in the literature was a patient who survived thirty-two years. Generally speaking, the prognosis is better in adults than in children Gastrointestinal involvement of a primary or secondary degree has a poor prognosis.

Hurthle-cell tumor. — This is a tumor that comes from and includes Hurthle cells of the thyroid. It is considered benign if there is encapsulation and no evidence of blood vessel invasion is present. Otherwise, it is malignant Approximately 3 per cent of all these adenomas show blood vessel invasion.

Treatment. — Surgical removal of the adenoma. If, upon removal, no blood vessel invasion is evident, no further treatment is necessary. However, if capsular invasion is present, the entire lobe and isthmus should be removed. Radiotherapy is contraindicated for adenomas. Only if there is evidence of extension to the regional lymph nodes is radiotherapy indicated.

Prognosis. — Good for those patients who show no evidence of blood vessel invasion. Prognosis is not as good for those patients who develop metastasis.

Hypernephroma. —A renal tumor with structure which resembles the tissue found in the cortex of the adrenal gland. The most common renal malignant tumor found in adults.

Treatment — Nephrectomy through surgery.

Prognosis — Poor. Less than 20 per cent survive.

Hyperpigmentation. — A condition in which there is extremely marked pigmentation. Not uncommon in negroes and dark skinned individuals Often the result of other diseases such as Addison's disease. There is no pathological significance.

Indolent growth. — A relatively painless tumor or abnormal formation

Induration — The quality of being hard or the process of hardening

Infectious granuloma. — A granuloma caused by a specific bacterium or other microorganism, resulting in such diseases as leprosy and Hodgkin's disease.

Treatment. — Will depend upon the specific disease to which the condition terminates Drugs, surgery, physical therapy, prophylaxis measures, radium and *x*-ray have all been used.

Prognosis. — All these diseases tend to run an unfavorable course.

Infiltrating tumor. — A tumor which is not clearly marked off from the surrounding tissue but tends to invade with projections.

Treatment and prognosis. — Will, of course, depend upon the type of infiltrative tumor.

Interstitial radiation — Radiation therapy carried on by inserting radium or radon into the tissues. If not carefully observed, radiation osteitis may result when deposited in the bones and necrosis may form.

Iron-hard tumor. — Riedel's struma is the iron-hard tumor. It is actually chronic inflammation of the thyroid causing constriction of the trachea and esophagus and hoarseness.

Treatment — Some benefit from *x*-ray treatment has been noted, if not, surgery is indicated.

Prognosis — Good

Islet cell tumor. — A tumor of the islands of Langerhans These islet cells are secretory cells located within the pancreas Tumors of the islet cells are almost always benign adenomas of islet tissue, but occasionally may metastasize to the liver or adjacent lymph nodes

Treatment — Surgery carried out by total removal of the tumor

Prognosis — Good, depending upon metastasis and early diagnosis

Ivory-like tumor. — The same as osteoma eburneum, or the conversion of bone into an ivory-like mass Practically all forms of condensing osteitis are thought to be pathological

Granulation tumor. — This tumor is most often due to infection spreading from the infected pulp to the periodontal membrane At the apex, there is a tendency to wall off the infection and for bacteria to enter the area The granulation tissue is formed at the expense of the bone. A fibrous capsule is formed by proliferating fibroblasts derived from the periodontal membrane. The granuloma may stay small for several years but sometimes it involves a large area of the jaw It may develop into a radicular cyst It rarely becomes the forerunner of epidermoid carcinoma.

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A recent treatment is by using nitrogen mustards These have unpleasant side effects The small number of cases treated thus far offer no definite advantage yet to the effectiveness of this course of treatment

Treatment. — Surgery.

Prognosis. — Poor due to rapid growth, especially if it reaches the inflammatory stages.

Leiomyoma. — A tumor made up of smooth muscle fibers. It is circumscribed and is encapsulated by connective tissue Occurs most frequently in the stomach. Malignant transformation to a leiomyosarcoma may occur

Treatment — Removal of the tumor by surgery.

Prognosis. — Good, if properly diagnosed in benign stage.

Leiomyosarcoma. — A sarcoma containing large smooth muscle cells.

Treatment — Surgery. However, in infiltration sarcomas resection is not feasible, these malignant mesenchymal tumors in general tend to be very radiosensitive and surprising results can be obtained.

Prognosis — Poor.

Lenticular carcinoma. — Scirrhous carcinoma of the skin with the formation of flattened papules and nodules which run together, forming fungoid masses It is most frequent in the upper quadrant of the breast. Progress is slower than the medullary type.

Treatment. — Surgery and radiation.

Prognosis — Good.

Lepidic tumor. — A lepidoma, a tumor derived from the lining membrane tissues of the embryo, or an endothelial tumor originating from the blood vessels or lymphatics. It grows large.

Treatment — Surgery.

Prognosis — Good.

Leukoplakia. — An epithelial overgrowth which may appear as a minute, single spot or as splotches with regular or irregular outline, and varying extent of area It may present itself as smooth white diffuse patches on the mucous membranes It may be thick or may be so thin that it is almost invisible

Treatment. — Small areas may be destroyed with cautery, or electrosurgery, or scalpel surgery. Large areas should be left alone and kept under observation Removal of all irritating factors, including certain foods

Prognosis — Good, if diagnosed in time.

Lichen planus. — A chronic dermatologic disease. The lesions appear as a fine network of white lines, arranged in a branching lacework pattern, which is found characteristically on the cheek mucosa.

Treatment — Destructive measures with surgery or chemicals are not indicated. Administration of arsenic and mercury separated or in combination gives good results.

Prognosis — Good.

Limbal tumor. — A tumor situated at the margin between the cornea and the conjunctiva of the eye.

Treatment. — Dependent upon the specific type of tumor

Prognosis — Dependent upon the specific type of tumor.

Lipoma. — A circumscribed mass of an adult type of fat tissue which is benign and is often multiple

Treatment — Surgery, also extracts from such glands as pituitary and thyroids

Prognosis — Good.

Lipomatous carcinoma. — A carcinoma containing much fat

Treatment — Surgery.

Prognosis — Fair, depending upon prompt and accurate diagnosis.

Liposarcoma. — A rare type of tumor composed of embryonic fat cells containing small fat globules in their granular cytoplasm Much of the tumor may be undifferentiated and highly cellular In some areas mature types of fat cells may be found

Treatment — Surgery in otherwise hopeless conditions
Prognosis. — Good.

Kaposi's sarcoma. — A multiple soft bluish nodule of the skin with hemorrhages under certain conditions developing neoplastic characteristics This is similar to the infectious granulomas, which will include such diseases as Hodgkin's, leprosy and others. Actually, it is undecided whether the condition should be classed as a chronic granulomatous inflammation or as a true tumor.
Treatment — Would be according, with such treatments as x-ray, radium, and surgery
Prognosis — Poor

Keloid. — An excessive formation of a fibrous scar resulting in a tumor-like mass resembling a fibroma It is particularly common following burns, is frequently multiple, and may reach considerable size It is found more often in the colored race
Treatment — Radium or roentgen rays or a combination of radiation and surgery yields good results
Prognosis — Good

Keratosis. — Any disease characterized by horny growths, resulting from a hyperkeratosis or thickening of the outer cornifying layers of epithelium. This is one of the most common precancerous lesions.
Treatment — Comprises the removal of the irritants which produce the growth, such as extreme thermal changes, tobacco, certain chemicals, and trauma
Prognosis — Good, if diagnosed in early stages.

Keratosis seborrheica. — A pigmented senile wart, but has been called epithelial papilloma, acanthotic nevus, benign melanotic epithelioma, and keratosis seborrheica. The clinical picture is that of a brown to blackish tumor which is sharply demarcated and appears as though pasted onto the skin, occasionally pedunculated
Treatment — Excision or destruction by electrosurgery or with the actual cautery under local procaine anesthesia
Prognosis — Good.

Krompecher's tumor. — The rodent ulcer or the basal-cell epithelioma which is derived from the basal-cell layer of the epidermis. May cause extensive ulceration and destruction of tissue and may also cause bone involvement
Treatment. — Most of these tumors are exceedingly radiosensitive in early stages, which means they can be treated with *x*-ray or radium. However, surgery is preferred in most cases
Prognosis — Good.

Krukenberg's tumor. — A special type of carcinoma of the ovaries due to spread from gastrointestinal tract or pelvic organs It is usually bilateral and is characterized by areas of mucoid degeneration and the presence of signet ring-like cells
Treatment — Surgery
Prognosis. — Poor to almost hopeless

Lacteal tumor. — A mammary abscess, or galactocele It is a cyst containing milk, resulting from a duct obstruction during lactation
Treatment — Surgery is indicated in any form of chronic cystic mastitis due to the high percentage that will go into cancer.
Prognosis — Good

Laparotomy. — An incision through the abdominal wall, usually for exploratory purposes

Large round-cell sarcoma. — Encephaloid or medullary cancer, a sarcoma with large or small cells resembling leukocytes It forms a soft, massive tumor, rapid in growth

Mesothelioma. — A tumor arising from any of the mesothelial tissues.
Treatment. — Depends upon extent and specific type of tumor and location.
Prognosis. — Depends upon extent, specific type and location.

Metastasis. — The transfer of disease or pathology from one organ or part to another not directly connected to it.

Migratory tumor. — A tumor arising from a portion of a primary tumor which has become detached from its original location and fixed in some other location or lies in a free cavity.
Treatment. — Depends on location and specific type.
Prognosis. — Depends on location and specific type.

Mixed cell sarcoma. — A connective tissue tumor made up of cells having variable size and shape, often with bizarre tumor giant cells.
Treatment. — Surgery and radiotherapy.
Prognosis. — Very poor.

Mixed cell tumors. — Tumors containing glandular elements, fibrous lipoid and angiomatous tissue. May be found in any part of the mouth. They are benign but can metastasize if the capsule ruptures.
Treatment. — Surgery and radiation.
Prognosis. — Good.

Mixed odontomas. — Pronounced disturbances of tooth development giving rise to atypical growths of all the dental tissues to form a mass having little or no resemblance to a tooth. They may be composed of intermingled enamel, dentin, pulp, and cementum having no regular order or arrangement of tissues, or they may be composed of a group of rudimentary tooth-like structures securely bound together by a continuity of one or more of the dental tissues.
Treatment. — Surgery
Prognosis. — Good.

Mixed tumor. — A tumor originating from one or two of the primary germinal embryonal layers as contrasted with teratomas or teratoid tumors which contain elements of all three germinal layers.
Treatment. — Would depend upon malignancy, extent and location, but surgery is best.
Prognosis. — Would depend upon malignancy, extent and location.

Mongolian spot. — A Mongolian spot, which may be single or multiple, is a bluish macule, much larger than a blue nevus. It is usually a poorly-defined brownish area in the skin over the sacrum
Treatment. — No treatment, they usually disappear.
Prognosis. — Excellent.

Monocytic leukemia. — A leukemia characterized by the presence of large mononuclear and transitional cell leukocytes. It tends to run a rather acute course.
Treatment. — Is symptomatic with attempt to remove the foci of infection.
Prognosis. — Poor.

Mucous cell carcinoma. — Krukenberg's tumor It is a carcinoma of the ovary resulting from cancer mestastasizing from the gastrointestinal tract, especially the stomach It is characterized by mucoid degeneration and signet ring cells
Treatment. — Surgery.
Prognosis. — Poor to hopeless

Mucous tumor. — A myxoma, a tumor consisting of mucous tissue Growth is slow and benign, but is often associated with carcinoma and sarcoma, which are malignant
Treatment. — By surgical removal or by electrothermic method
Prognosis. — Favorable

Multilocular adamantinoma — The frequent form of adamantinoma in which extension of invading epithelium produces additional cystic formations.

Treatment — Wide surgical excisions, also radiotherapy has proven beneficial

Prognosis — Poor, due to recurrences

Lymphangioma. — A tumor composed of newly formed lymph spaces and channels It is soft, velvety and made up of small nodules

Treatment — Surgery

Prognosis — Poor unless well localized

Lymphocytic leukemia. — A leukemia in which the leukocytes are lymphocytes or lymphoblasts, often confused with Hodgkin's disease.

Treatment — Surgery However, at present radium and x-ray are the most favorable

Prognosis — Unfavorable

Lympho-epithelioma. — A tumor arising from modified epithelium overlying lymphoid tissue of the nasopharynx

Treatment. — Surgery

Prognosis — Poor due to hemorrhage and extensiveness of mass.

Lymphogranulomatosis. — See Hodgkin's disease

Lymphomatous tumors. — Tumors consisting mainly of lymphoid tissues.

Treatment — Depends upon the specific type of tumor

Prognosis. — Depends upon the specific type of tumor

Lymphoma. — A tumor consisting mainly of lymphoid tissue

Treatment. — Surgery, x-ray and radium

Prognosis — Poor

Lymphosarcoma. — Malignant neoplasm resulting from the proliferation of atypical lymphocytes

Treatment — Wide surgical excision and radiotherapy

Prognosis — Poor due to recurrences

Malignant melanoma. — A tumor composed of melanin-pigmented cells with a tendency to progress in virulency

Treatment — Surgery, by excision of involved nodes, and irritated nevi

Prognosis — Ranges all the way from hopeless to good, depending upon the location and extent

Malignant tumors. — A malignant tumor is more rapid in growth, will extend to and infiltrate the normal structures, is not encapsulated, involves the regional lymph nodes, and is usually composed of more embryonic or poorly differentiated cells

Treatment — Will depend upon the type and location

Prognosis — Will depend upon the type and location

Medulloblastoma. — A tumor of the cerebellum composed of undifferentiated cells with a tendency to spread to the meninges is known as medulloblastoma

Treatment — Surgery Radiation is only temporary

Prognosis — Poor

Melanin. — A dark amorphous pigment found in skin, hair, tumor, and choroid coat of the eye

Melanoblast. — A cell which contains melanin pigments which it has produced.

Melanoma. — A tumor composed of melanin pigmented cells.

Treatment — Surgery and removal of irritating factors.

Prognosis — Ranges from hopeless to excellent, depending upon malignancy and extent and location

Melanophore. — A cell containing granules of yellow, red, brownish and black melanin

Meningioma. — A tumor developing from the leptomeningeal cells which line the arachnoid villi

Treatment. — Surgery

Prognosis. — Poor due to extension

Neurofibroma. — A connective tissue tumor arising from the sheaths of cranial or peripheral nerves. It is slow growing and benign.
Treatment. — Surgery.
Prognosis. — Fair.

Neurofibromatosis. — A familial condition characterized by developmental changes in the nervous system, muscles, bones, and skin and marked superficially with the formation of multiple, pedunculated, soft tumors, (neurofibromas) distributed over the entire body associated with areas of pigmentation. These tumors are benign.
Treatment. — Surgery and radiation therapy.
Prognosis. — Fair.

Neurogenic sarcoma. — A sarcoma originating from the connective tissue of the nervous system. Malignancy will vary with the number of mitoses and giant tumor cells and the scarcity of fibers.
Treatment — Surgery, cauterization, and implantation of radon seeds.
Prognosis. — Poor.

Neuroma. — A tumor composed of nerve fibers and nerve cells. They are benign and vary in size.
Treatment. — Excision by surgery. It has been reported that hypodermic administration of fibrolysin produces good results.
Prognosis. — Fair.

Nevus. — A mole or birthmark It is a general term to include new growth on the skin of congenital origin which may be vascular or avascular. It is benign.
Treatment. — Excision by surgery.
Prognosis. — Excellent.

Nonmalignant. — Benign, non-infiltrative, or favorable for recovery
Treatment — Depends upon specific type
Prognosis — Favorable.

Obturator. — An appliance which closes a cleft or fissure usually in the palate.

Odontoma. — An overgrowth or misplacement of the enamel, dentin, cementum, or combination of two or more of these tissues.
Treatment — Excision by surgery.
Prognosis. — Good.

Organoid tumor. — A teratoma, a tumor containing fetal remains congenitally derived, such as teeth and hair.
Treatment. — Surgical removal.
Prognosis — Favorable when growths are removed early.

Ossifying fibroma. — An ossifying fibroma is composed of a large amount of cellular tissue and a small amount of bone. It has its origin in the subperiosteum of the bone
Treatment — Surgery
Prognosis — Favorable, if diagnosed and treated early

Osteogenic sarcoma. — Malignant tumors of bones. Their origins are associated with the periosteum and probably with undifferentiated osteoblastic cells. They readily destroy the bone cortex and involve the medullary portion. Varying amounts of new and poorly calcified bone are formed, the spicules of which have a tendency to be built at right angles to the long axis of the tumor.
Treatment — Surgery This tumor is radioresistant.
Prognosis — Poor, but more favorable in older patients

Osteoma. — Osteomas are composed of large amounts of well formed bone with less cellular elements They have their origins in the subperiosteum of the bone They are benign tumors
Treatment. — Surgical removal.
Prognosis — Good

Osteoma eburneum. — Same as ivory-like tumor

Treatment.—Complete surgical removal (resection) and cautery, and heavy prolonged irradiation have proven helpful.
Prognosis.—Good, if surgical procedures are carried out widely.

Muscular tumor.—A myoma. Any tumor made up of muscular elements. If it is striated, it is a rhabdomyoma; if not, it is a leiomyoma. Tumor is benign when not associated with malignant growths.
Treatment.—Surgical removal.
Prognosis.—Good.

Myelocytic leukemia.—A blood disease composed of the leukocytes originating in the bone marrow, that is, polymorphonuclears, myelocytes, and myeloblasts.
Treatment.—All treatments known for leukemia are unsatisfactory, however, x-ray, and removal of foci of infection should be effected.
Prognosis.—Poor.

Myeloma multiple.—A neoplasm formed from bone marrow cells involving the entire skeleton. It is highly malignant and spreads rapidly to involve more bone.
Treatment.—Surgery.
Prognosis.—Poor.

Myoma.—Any tumor made up of muscular elements. This classification can be further broken down as to the type of muscle involved. Tumor is benign.
Treatment.—Surgical removal.
Prognosis.—Good.

Myxochondroma.—Tumor composed of both cartilaginous and mucous type tissue found normally in the umbilical cord. It is benign and is often found in the small bones of the hands and feet.
Treatment.—Surgical removal.
Prognosis.—Good.

Myxoma.—A tumor consisting of mucous tissue. Growth is slow and benign, but is often associated with carcinoma and sarcoma.
Treatment.—By surgical removal or by electrothermic method.
Prognosis.—Favorable.

Nelaton's oozing tumor.—A rare disease, consisting of a large flat tumor on one or both labia majora, divided with deep fissures, and discharging a large amount of acid, offensive fluid.
Treatment.—Surgery.
Prognosis.—Poor, due to the fact that most tumors of the vulva are there through implantation.

Neoplasm.—An overgrowth of cells which are independent of normal growth controls, serve no useful purpose, and are often injurious to normal tissue.
Treatment.—Surgical removal.
Prognosis.—Good.

Neurilemmoma.—Connective tissue tumors arising from the sheaths of cranial or peripheral nerves.
Treatment.—Surgical removal.
Prognosis.—Fair due to benign state.

Neurinoma.—A benign tumor of a nerve originating in the sheath of Schwann.
Treatment.—Surgical removal.
Prognosis.—Fair due to the benign state.

Neurocytoma.—A brain tumor consisting of undifferentiated cells of nervous cells, that is, cells resembling medullary neural epithelium. The term is applied also to certain round cell sarcomas of the adrenals and liver of infants, which are apparently derived from sympathetic formative cells, and which are known also as neuroblastoma, and sympathoblastoma.
Treatment.—Removal by surgery and therapy against infection.
Prognosis.—Poor.

Pseudo-intraligamentous tumor. — A kind of tumor of the ovary simulating intraligamentous tumors, but in reality adherent to the posterior surface of the broad ligament

Radicular cyst. — A cyst usually formed around the apex of a pulpless tooth. It most often appears roentgenographically as a dark area surrounded by a white line.

Radiology. — That branch of medical science which deals with the use of radiant energy in the diagnosis and treatment of diseases.

Radioresistant. — Resisting complete sterilization by radiation.

Radio-responsive tumors. — Those tumors which require 2,500 to 5,000 r for similar regression. Adjacent normal tissues show definite reaction, but without permanent injury.

Radio-sensitive tumors. — Those tumors which regress or clinically disappear with a dose of 2,500 r or less, usually without apparent damage to adjacent normal tissue.

Radiotherapy. — The treatment of disease by application of roentgen rays, ultra-violet rays, radium, and other radiations.

Radium. — A metallic element found in very small quantities in pitchblende. It has an atomic weight of 226.4 and does not seem to exist in a free state. It is unstable, radioactive and fluorescent, becoming darker on exposure to light.

Radium intratumoral application. — Implanting radium into tumors for therapeutic purposes.

Radium emanation. — Heavy, colorless, gaseous element giving off in disintegration of radium.

Radon. — A heavy radioactive gas given off in the disintegration of radium Same as radium emanation

Radon seed. — A small capillary tube of glass containing radon suitable for implantation in tissues. This tube is usually placed inside a gold or platinum tube

Ranula. — A large cystic tumor seen under the tongue on either side of the frenum. The swelling may be small or large. It is semitranslucent; soft, large, dilated veins coursing over it. There is usually no pain but a feeling of fullness and discomfort persists. It contains clear, glassy fluid due to dilation of ducts of salivary glands and to obstruction of those of sublingual mucous glands

Treatment — Surgery by Partsch operation.

Prognosis — Good.

Rehabilitation. — The rendering of physically or mentally handicapped persons fit to engage in a remunerative occupation.

Reticulum-cell sarcoma. — A malignant tumor of lymphatic tissues or lymph nodes in which the cells are often angular, and are intimately connected to reticulum fibers.

Retinoblastoma. — A tumor arising from the retina of the eye. It may be either flat or elevated It may replace all the structures of the eye and invade the bone. Necrosis within it is common and frequently small areas of calcification can be seen. It often forms a large exoptic, ulcerated, infected mass The tumor frequently invades the underlying facial bones and base of the skull, spreading directly to involve the meninges.

Treatment — Surgery with the removal of all infected parts is the treatment of choice As much of the optic nerve as possible should be removed. If evidence of a postoperative tumor of the optic nerve is evident then irradiation is indicated

Prognosis. — Poor.

Rhabdomyoma. — A benign tumor of the striated muscle of the heart. It is generally considered benign Ewing attributes its origin to teratomatous growths. It may be single or multiple.

Over-radiation. — Over-exposure or too frequent exposure to x-rays producing erythema, dermatitis, keratosis, alopecia, sterility, and blood dyscrasias is known as over-radiation

Palliative treatment — Therapy directed at relief of pain or symptoms without necessarily producing a cure

Pancoast's tumor — Pulmonary sulcus tumor.

Treatment. — Would depend upon the specific type of tumor

Prognosis — Would depend upon the specific type of tumor

Papilloma. — A hard rough tumor with a broad base which may be several centimeters in diameter The surface is rough and fissured, often with marked keratinization of the superficial cells

Treatment — Surgery, cautery, and radiotherapy.

Prognosis — Excellent

Periportal carcinoma. — Cancer of the liver extending along and around the portal vessels

Treatment — Surgical excision of the tumor Medical treatment is limited to palliative measures and simple nutritious foods.

Prognosis. — Poor.

Phantom tumor. — An abdominal swelling due to a neurosis and not to a structural change, it is generally due to a gaseous distention of the bowel

Pigmentation. — The deposition of coloring matter, the discoloration or coloration of a part by a pigment

Potato tumor — A hard nodular tumor of the carotid body

Pott's puffy tumor — A circumscribed edema of the scalp associated with osteomyelitis of the skull bones

Precancerous lesion — A benign lesion either inflammatory or neoplastic in nature, which sometimes becomes malignant Some examples of precancerous lesions are benign moles, gastrointestinal polyps, keratoses, adenomas of the thyroid and exostoses It cannot be determined from the structure of any particular lesion whether it would have become cancerous if allowed to remain It is merely known that cancer develops with greater frequency from such lesions than from normal tissue

Pregnancy tumor. — This is also known as stomatitis gravidarum and occurs in some pregnant women about the second month of gestation It is marked by a gingival hyperplasia which in extreme cases gives use to pedunculated tumors that form from the gingival papillae. They are thought to be due to growth stimulation by hormonal activity associated with pregnancy. These tumors are likely to recur after excision even if cauterized, but sometimes they recede spontaneously after parturition

Prickle-cell epithelioma. — A malignant tumor with cells derived from the prickle zone of the epidermis or the mucosa There is an irregular downgrowth of the epidermis, with strands of prickle cells breaking through to the basal-cell layer. Some of the cells become keratinized forming whorls If this condition is recognized early and adequate treatment is instituted immediately, most of the victims of this disease can be saved If metastasis has occurred, surgery and radiation may not control it. For lesions diagnosed before metastasis has occurred and before invasion, surgery is the best treatment Advanced cases may be treated by a combination of surgery and radiation

Primary lesion. — The first lesion to appear in syphilis, spoken of as a chancre These lesions are solitary, seldom multiple; they have the appearance of ulcerations or tumefactions with rapid progression and regional adenopathy They are indurated and painless

Prosthesis. — An artificial substitute for a missing part, as a denture, hand, leg or eye

Prosthetics. — The branch of surgery which deals with prostheses

Prosthodontist. — A dentist who specializes in prosthetic dentistry.

Solar cautery. — A glass lens for concentrating the sun's rays upon tissue for the purpose of preventing or inhibiting further growth.

Spiegler's tumor. — A benign multiple epithelioma of the scalp.

Spindle cell sarcoma. — A tumor somewhat harder in the gross and less prone to degenerative changes and malignancy than the round-cell forms. It is composed of elongated spindle-shaped cells with elongated nuclei.

Splenadenoma. — Enlargement of the spleen caused by hyperplasia of the spleen's soft parenchyma.

Spongioblastoma. — A malignant, rapidly growing brain tumor, thought to be derived from embryonic spongioblasts, characterized by spindle and degenerative changes.

Squamous cell. — A thin, flat, scaly epithelial cell.

Squamous cell carcinoma. — This tumor is characterized microscopically by the differentiation of cornified epithelium and prickle cells. The growth begins in multiple adjacent foci in the epidermis. Masses of cells grow downward into the corium A dense zone of small lymphocytes is found immediately beneath the epidermis, when the epithelial invasion begins, but the lymphocytes do not invest epithelial masses that have penetrated some distance from the epidermis. Cornification begins in the center of the tumor masses. Concentric layers of cornified epithelium are called "epithelial pearls" Those with much keratinization (pearl formation) are generally of a lower grade malignancy.

Squamous cell epithelioma. — A malignant tumor whose cells are derived from the prickle zone of the epidermis or the mucosa. Metastasis to the regional lymph nodes or to other parts of the body may occur early or fairly late, depending upon many factors such as cell type, slow, or prompt and adequate treatment.

Stomatitis gravidarum. — Same as pregnancy tumor.

Sympathicoblastoma. — A malignant tumor made up of primitive sympathetic nerve cells.

Synovioma. — A tumor arising from the synovial membrane lining the capsule of a joint.

Teratism. — An anomaly of conformation which may be congenital or acquired

Teratoid. — Resembling a monster.

Teratoma. — A congenital tumor containing embryonic elements of all three primary germ layers, as hair, teeth and such

Theca-cell tumor. — A thecoma, a fibroid-like tumor of the ovary containing yellow areas of lipoid material and derived from theca cells, regarded by some as a granulosa-cell tumor. Thecomae are invariably benign and unilateral and do not reach a large size, usually measuring between 5 and 10 cm. Theca-cell tumors, in contrast to the granulosa-cell tumor, are rarely observed before thirty-five years of age. Microscopic examination of the thecoma reveals large amounts of connective tissue and when stained, large amounts of sudanophilic material are observed

Treatment. — Surgical removal

Prognosis — Good.

Thermophore. — Apparatus for applying heat to a part, consisting of water heater and tubes conveying water to a coil and returning to heater, or salts which produce heat when moistened This is considered a type of local treatment

Tomato tumor. — A benign multiple epithelioma of the scalp

Totipotent. — Totipotential — Capable of all, said of cells which can give rise to cells of all orders, *i e*, the complete individual

Transitional tumor. — A benign tumor which, if it recurs after removal, may become malignant

Tridermic tumor. — A dermoid cyst derived from the three embryonic layers, the ectoderm, endoderm, and mesoderm.

Rhabdomyosarcoma. — The malignant form of rhabdomyoma.

Rodent ulcer. — A basal-cell carcinoma with deep penetration. Metastasis is infrequent and late

Treatment — Actual cautery It is resistant to radiation

Rokitansky's tumor. — A kind of dropsy of the graafian follicle, forming a small pedunculated cyst The ovary has the appearance of a bunch of grapes.

Sailor's skin or farmer's skin. — A frequent cause of cancer. A condition of the skin caused by long-continued exposure to the sun's rays over a period of years It implies somewhat of an idiosyncrasy to the action of such radiation. The result is a presenile skin, with atrophy, pigmentation and dryness, sooner or later keratosis develops. The lips are frequently affected with this keratosis and it may exist for many years It is potentially very dangerous because a large percentage of cases develop into squamous cell epithelioma.

Treatment — Keratosis of the lips should be destroyed by electrodesiccation under local procaine anesthesia as soon as diagnosis is established.

Sarcoma. — A tumor of nonepithelial, modified, embryonic, connective tissue which may affect the bones, bladder, kidneys, liver, lungs, parotids and spleen

Schloffer's tumor. — An inflammatory swelling of the abdomen after herniotomy or any other abdominal operation.

Schmincke's tumor. — A lymphoepithelioma originating in Waldeyer's ring of tissue in the nasopharynx and extending through the base of the skull into the cranium to involve the cerebral nerves at the base of the brain It metastasizes to the lungs, lymph nodes, abdominal viscera, and the bones.

Scirrhus. — A hard, cancerous tumor due to overgrowth of fibrous tissue Seats of predilection are alimentary tract, especially pylorus end of stomach and in a few cases glands of the skin

Treatment — Is palliative, relieving pain, and making patient comfortable as possible, or radical treatment Prompt extirpation of all diseased tissues

Sebaceous tumor. — A cyst filled with sebaceous material from a distended sebaceous gland It is sometimes known as wen and frequently occurs on the scalp Drainage does not remove it permanently as it will recur unless entirely extirpated, which should be done with an electric current or cutting knife

Seborrhea. — A chronic disease of the sebaceous glands often marked by the occurrence of an excessive discharge of sebum from the glands Sebum, a thick semifluid substance composed of fat epithelial debris from the cells of the Malpighian layer, in excessive quantities may form white or yellowish, greasy scales on the body It is generally attended with itching or burning.

Seborrheic keratosis. — A chronic form of thickening and irritation which may involve the major portion of the exposed mucous surface of the lips. The areas of keratosis, which may peel off and recur over a period of years, may become the site of malignant change The extent of the lesions makes excision of such precancerous areas a questionable procedure and better results may be obtained by irradiation.

Sheath tumor. — A tumor of the brain sheaths. This includes meningioma and acoustic nerve tumor.

Small round-cell sarcoma. — A rather well-demarcated pinkish-white fleshy mass which tends to be rapid in growth and metastasis Often there are areas of degeneration and hemorrhage Microscopically, its composition is small, uniform, round cells, abundant in thin-walled blood vessels

Solanoid carcinoma. — A solanoma, the texture of which resembles a raw potato.

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True tumor. — Any tumor which is produced by proliferation.

Tuberculoma. — A conglomerate caseous tubercle, usually solitary, which has attained such a size as to suggest the appearance of a tumor.

Tuberous carcinoma. — A scirrhous carcinoma of the skin with the formation of nodular projections.

Tumor. — A swelling Specifically, a new growth of cells or tissues characterized by autonomy, that is, independent of the laws of growth of the host It is progressive, of unknown cause, and in malignant form limited only by the nutrition provided by the host

Tumor albus. — A white swelling, tuberculosis of bone or joint

Tumor albus pyogenes. — A chronic inflammation of gunshot injuries of the bones and joints. It is characterized by great swelling of the capsule of the joint and surrounding soft parts, which become converted into a gelatinous, edematous granulation tissue.

Tumor colli. — A tumor in the neck.

Tumor lienis. — An enlargement of the spleen to a lesser degree than in splenomegaly.

Turban tumor. — A multiple benign epithelioma of the scalp grouped together so as to cover the entire scalp

Varicose tumor. — A swelling of purple color, made up of dilated veins.

Vascular tumor. — An aneurysm; an angioma, a bleeding internal hemorrhoidal growth

Villous tumor. — A papilloma

Von Recklinghausen's disease. — In a classical case of Von Recklinghausen's disease there are multiple tumors of the skin and usually tumors of the larger nerves at the same time. The disease may last for years with only a slow increase in size of the tumors, but in time one or more often becomes sarcomatous and enlarges rapidly The susequent course is that of a malignant sarcoma. The disease is definitely familial and hereditary It is sometimes accompanied by deformities of the bones which aid in diagnosis Subperiosteal tumors cause absorption of bone and appear as cysts on radiograph. Bone destruction may cause shortening or lengthening of one lower extremity, with scoliosis resulting. Elephantiasis or spina bifida may be found In Von Recklinghausen's disease death is usually due to pressure from an intraspinal or intracranial tumor or to a sarcomatous change in a fibroma

Warty cicatricial tumor. — A neoplasm which appears in a set of warty growths in parallel lines on the surface of a scar, it often breaks down and becomes what is known as Marjolin's ulcer.

White tumor. — A chronic tuberculous arthritis

Wilms's tumor. — An embryonic mixed growth which is practically the only malignant renal tumor of children. Nearly 90 per cent appear before the age of seven years, but an occasional renal tumor is one of the Wilms's type The first symptom is usually an enlarged kidney, and the tumor grows rapidly producing a great enlargement of the abdomen, emaciation and death in a few months

The age of the patient, the size of the tumor, and the pathologic character do not influence the prognosis A Wilms's tumor may be considered cured in 95 per cent of the cases if eighteen months have elapsed after operation without evidence of local recurrence or distant metastases. The over-all prognosis is certainly better than is generally appreciated. Hematuria is usually an ominous sign None of the patients with hematuria reported by one investigator survived

Xanthoma. — A flat, slightly elevated, soft, rounded, chamois-covered plaque or nodule, usually on the eyelids It may occur in patches of yellowish macule on orbital regions, is confined to middle life or later, and to the female sex It consists of a degenerative process involving fibers of the orbicularis muscle. It is treated by carbon dioxide snow and by carbon arc light.

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